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OF THE

British Astronomical Association.

VOL. XX.—PART IV.

TENTH REPORT OF THE SECTION

FOR THE OBSERVATION OF

MARS,

DEALING WITH THE APPARITION OF 1911–1912.

Director—E. M. Antoniadi, F.R.A.S.

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SECTION FOR THE OBSERVATION OF MARS.

DIRECTOR.—E. M. ANTONIADI, F.R.A.S.

REPORT OF THE SECTION, 1911–1912.

PART I.

PROLEGOMENA.

1. The Apparition of 1911–1912.

This favourable opposition occurred on 1911, November 25. A week previously, the planet was at the distance of 0·511 (47,400,000 miles), whereas in 1909 he approached the Earth as near as 0·389 (36,000,000 miles). Consequently, the diameter of Mars in 1911 attained only three-fourths of that of 1909; a difference which was not compensated by his greater altitude above the horizon in northern latitudes.

Phenomena.

Mars in Perihelion	1911, July 1.
Winter Solstice of N. hemisphere Summer Solstice of S. hemisphere	1911, August 2.
Mars in W. Quadrature with the Sun	1911, August 9.
Mars in Apparitional Perigee	1911, November 17.
Diameter of Mars in Apparitional Perigee	18″·3.
Mars in Opposition with the Sun	1911, November 25.
Heliocentric longitude of Mars in Opposition	61° 49′.
Position of Mars in Opposition	$\alpha = 3^h\ 58^m$. $\delta = +\ 21^\circ\ 43'$.
Diameter of Mars in Opposition	18″·1.
Position angle of the N. pole of Mars in Opposition	325°.
Latitude of the centre of the disk at Opposition	− 9°·4.
Vernal Equinox of N. hemisphere Autumnal Equinox of S. hemisphere	1912, January 8.
Mars in E. Quadrature with the Sun	1912, March 4.

The negative latitude of the centre of the disk varied from $-20^{\circ}\cdot8$ on 1911, July 1, to $-5^{\circ}\cdot4$ on October 12; it then increased to $-14^{\circ}\cdot8$ on December 30; and again began to diminish, attaining 0° on 1912, April 3, after which it became positive.

2. The Members of the Section and their Instruments.

The following table gives the names of the Members who constituted the Mars Section in 1911–1912, the aperture of their telescopes, as well as the number of drawings forwarded by each to the Association :—

Observer.	Locality.	Aperture of Instrument in Inches.	Drawings.
ANTONIADI, E. M., F.R.A.S.	Meudon, France -	8½ Spec. 32¾ O.G.	32
BACKHOUSE, T. W., F.R.A.S.	Sunderland - -	4¼ O.G.	14
BUCHANAN, W. E. - -	Simla, India - -	16 Spec.	—
HEPBURNE, P. H., LL.B., F.R.A.S.	Hampstead - -	8 Spec. 12½ Spec.	—
MCEWEN, H. - - -	Glasgow - -	5 O.G.	47
O'HARA, C. - - - -	Derrylin, Ireland -	8⅛ Spec.	14
PHILLIPS, REV. T. E. R., M.A., F.R.A.S.	Ashtead, Surrey -	8 O.G. 12¼ Spec.	22
PRICE, W. S. - - -	Wellington, Somerset.	8½ Spec.	1
THOMSON, H., F.R.A.S. -	Newcastle-on-Tyne	8½ Spec. 12½ Spec.	13
	Ashtead, Surrey -	8 O.G. 12¼ Spec.	
WILLIAMS, A. STANLEY, F.R.A.S.	Hove, W. Brighton	6½ Spec.	—
			143

The observations cover a period of 7 months and 8 days, the two extreme records, both due to McEwen, being 1911, August 7, and 1912, March 15.

3. Telescopic Notes and Atmospheric Definition.

REFLECTORS AND REFRACTORS.—Phillips, who has been very successful on Mars in 1911–1912, writes: "I have been "making a comparison between the 12¼-inch Calver and 8-inch "Cooke on Mars.

"On poor nights (*i.e. most* nights) the advantage is un- "questionably with the refractor. On really good nights, the "Calver beats the Cooke . . . . . in truth of *colour*, in *light* "*grasp*, and *depth of contrast*, and in its power to show *minute* "*detail*.

"The images, of course, are *steadier* in the refractor, and this "makes it the more serviceable instrument for general work, "but the ultimate court of appeal must certainly be the "reflector."

POWER.—Backhouse, whose retina must be extremely sensitive to faint half-tones, applied with success 370 on his $4\frac{1}{4}$-in. "Observers with large instruments," says the Sunderland astronomer, "usually use lower powers than I should expect. "No doubt it is from the difference between different eyes, and "some are much keener in detecting small objects than I am, "whereas I can see faint objects better when they are large."

THE WEATHER.—Derrylin is described by O'Hara as "one "of the wettest and most unfavourable localities in the British "Isles for star-gazing"; but up to 1911, October 10, the season there was "unusually favourable." Phillips found "the seeing "conditions . . . . . invariably poor" before November. Price noted that, "notwithstanding the high altitude, the air has been "very unsteady," and that, "except for momentary glimpses, "definition has been poor." Also, Thomson speaks of the "exceedingly bad observing conditions with wretched defini- "tion" up to November. Nor was the seeing at Meudon better, since the duration of calm images in 1911–1912 was counted there by seconds, whereas in 1909 there were hours of definition without quivers in the large instrument. Yet by utilizing to the utmost these fugitive gleams, and by taking full advantage of a few good views of short duration, it has been possible to add some valuable data to the results obtained during the previous apparition.

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4. The Colours of the Disc, and the Lune of Brown Spots on Mars.

Thomson speaks of the "reddish pink" colour of the planet and finds the *maria* "bluish grey."

According to the Director, the ochre tint of the "continents" is not uniform, as *Candor* and *Nix Atlantica* at least form brighter parts of the surface.

McEwen saw many brown tints: "Brown ochre," "dark "brown ochre," "burnt yellow ochre," "sepia," "warm sepia," "pale warm sepia," "raw umber," "Venetian red," "Indian red," "Van Dyke brown," "faint brown," "terra cotta," "dull burnt "yellow," etc. The Director, who has been deceived by the apparently green colour of the *maria* in the $8\frac{1}{2}$-in. Calver on 1909, August 16 and 22,* does not think that these impressions correspond to brown areas on Mars. Thus, on 1911, December 28, at 19^h G.C.M.T., the Glasgow observer saw *Maria Sirenum* and *Cimmerium* "dark sepia," whereas an hour later, under good

* *Mars Report* for 1909, p. 34.

seeing, he described them "Delft blue." Again, on 1912, January 7, *Margaritifer Sinus* and *Auroræ Sinus* appeared to McEwen, at $17^h\ 10^m$, "sepia tint"; but, 50^m later, they were "Delft "blue." Lastly, on the same evening, *Bosporos Gemmatus* looked "faint raw umber" at $17^h\ 10^m$, in order to turn "Delft blue" after two hours; and so on.

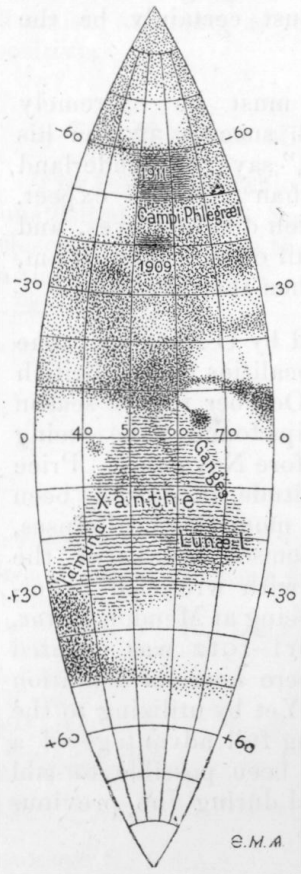

FIG. 1.—The Martian lune of brown spots (Meudon, 1909 and 1911–1912). The brown areas are here indicated by wavy, horizontal lines.

A temporary brown tinge may be produced on Mars by orange cloud, transparent enough to render partly visible the grey shadow cast by it on the surface. But, apart from this, we have extensive districts on the planet showing a preponderance of brown colour. As far as the Director's observations with the large instrument go, these brown spots are all grouped in the lune extending from $\Omega = 30°$ to $80°$ (Fig. 1), and cover a surface of more than 1,700,000 square miles. In fact, *Campi Phlegræi*, 1911, measure some 160,000 square miles; *Campi Phlegræi*, 1909, if not identical with part of the preceding, some 50,000; while *Xanthe*, with *Lunæ Lacus*, extends over nearly 1,500,000 square miles.

No aperture under 20 inches would probably reveal these brown colours; and even then an experienced eye would be indispensable.

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5. The Abnormal Conspicuousness of the irregular curved Band Nepenthes-Thoth-Casius.

This was the most remarkable feature of the 1911–1912 apparition. Whenever *Syrtis Minor* was near the C.M., a broad, dark band, convex to S.E., appeared to run out of *Mœris Lacus* in a N.E. direction, and to extend beyond *Nubis Lacus*, into *Utopia*. A vast change had apparently occurred here since 1909 (Figs. 2 and 3); and Phillips, Price, Thomson, Stanley Williams, and the Director were all struck by the extraordinary boldness and definiteness of this marking.

An enquiry into the phenomena presented in the past* by the irregular streak in question led the Director to the following conclusions :—

(*a*) That the *Nepenthes-Thoth* system is liable to darken greatly occasionally, at long intervals of time ;

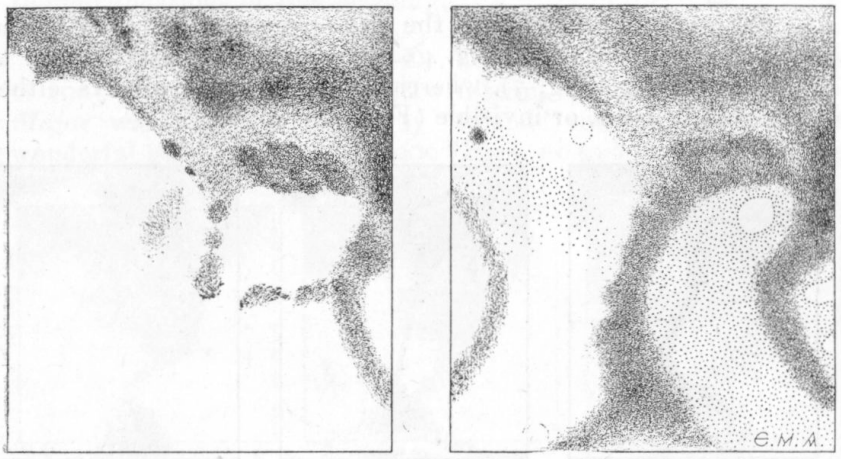

FIG. 2.—1909. FIG. 3.—1911.

Recurrent change in the appearance of *Nepenthes-Thoth*.
(The Director, 32¾-in.)

(*b*) That the change is not seasonal, as the band has been observed to be very dark and striking in widely different heliocentric longitudes of the planet ; and

(*c*) That, although its usual faintness may be accounted for by an almost constant interposition of yellow cloud, yet it seems more probable that we are confronted here with a real, recurrent intensification of the surface.

6. The Question of Objective Change on the Surface of Mars, and the Periodical Character of the Modifications of Syrtis Major.

The momentous part played by cloud in modifying the apparent configuration of Mars was fully illustrated in the last Reports of the Section. But the question of change on the very surface of the planet, apart from the melting of the snows, was dealt with with reserve in the Memoir for 1909. Since then, the Director has investigated this problem with all the available data, and concluded that the Martian soil is subject to local alterations, of which some are (1) secular, others (2) recurrent, and others (3) seasonal.

(1) SECULAR CHANGE.—In 1909, a dusky mark, *Scorpii Palus*, was quite conspicuous to the S. of *Cerberus*.† Although

* *See* p. 165, note.
† *Mars Report* for 1909, p. 74.

accessible to ordinary appliances, it was never seen before ; nor was it visible in 1911–1912.

Pambotis Lacus, usually a small grey spot, which eluded the acuteness of Schiaparelli, was quite as large and dark as *Trivium Charontis* in 1907.* At the following apparitions, however, it had shrunk to its usual insignificance.

Schiaparelli found† that the *Hydaspes* was very broad and dark to Secchi in 1858 (Fig. 4), and somewhat less marked to Dawes in 1864 (Fig. 5), whereas this object is always either exceedingly faint, or invisible (Fig. 6).

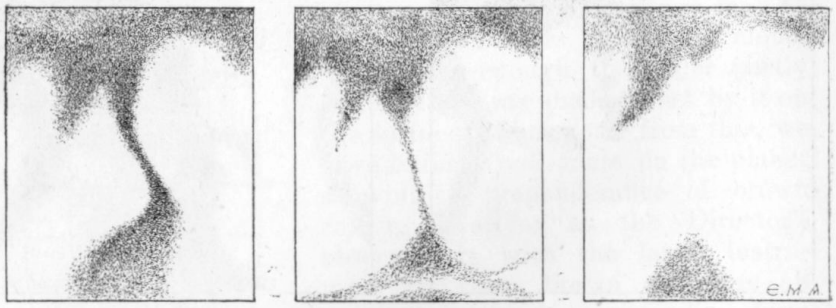

FIG. 4.—1858. Secchi. FIG. 5.—1864. Dawes. FIG. 6.—1905. Ward.

Secular changes in the appearance of *Hydaspis Sinus* and *Hydaspes*.

Lastly, Van de Sande Backhuyzen has called attention to the extraordinary development of the *Cyclops* at the close of the XVIIIth century,‡ when it appeared most extended and conspicuous to Herschel (Fig. 8) and to Schroeter (Fig. 9). However, some 80 years previously, Bianchini drew no "gulf"

FIG. 7.—1719. Bianchini. FIG. 8.—1783. W. Herschel. FIG. 9.—1800. Schroeter. FIG. 10.—1911. The Director.

Secular changes in the configuration of the *Cyclops-Cerberus*.

at all here (Fig. 7). In 1900-1901, Kibbler and Molesworth saw dusky the region of *Cyclopia*.§ But in 1911, through clear Martian skies, there was, at Meudon, nothing noteworthy in this part of the planet (Fig. 10).

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* *Mars Report* for 1907, pp. 90–91.
† *H. and E.*, 1889.
‡ *On the Rotation Period of Mars*, Leyden, 1885.
§ *Mars Report*, 1900–1901, p. 115, and Chart, Plate I.

(2) RECURRENT CHANGE.—*Nepenthes-Thoth*, so dark and broad in 1911–1912, when Mars was in heliocentric longitude 35° to 95°, was also easy in 1894, in longitude 25°, and again very conspicuous in 1888, between heliocentric longitudes 210° and 256°. Hence the recurrent, but not seasonable, character of the modifications of this marking.

(3) SEASONAL CHANGE.—Dr. Lowell's beautiful photographs of 1905 and 1907 show that the district immediately *p. Syrtis Major* was darker a long way "inland" than on Prof. Hale's wonderful glass positives of 1909 (Figs. 11 to 13). It is to this

FIG. 11.—1905. Dr. Lowell. FIG. 12.—1907. Dr. Lowell. FIG. 13.—1909. Prof. Hale.

Periodical changes in the intensity of the district to the left of *Syrtis Major*, after the American photographs.

darkening of the adjoining country that the apparent encroachments of the *Syrtis* on *Libya* and *Isidis Regio*, detected by Schiaparelli,* should be attributed. Now, a careful analysis of the observations since 1858 has led the Director to the conclusion that *Syrtis Major* looked narrow after perihelion† in 1862, 1864, 1877, 1892, and 1909, and very broad after aphelion in 1858, 1873, 1890, and 1905. The maximum narrowness occurs at about 15° of heliocentric longitude. After 70° ±, the *Syrtis* expands, attaining its greatest breadth when Mars is in longitude 230° ± ; and there is a somewhat rapid shrinkage towards heliocentric longitude 290°.

It will be seen that, in all these cases, the assumption of real, superficial change on Mars is more plausible than that of cloud ; for it is difficult to conceive yellow dust remaining immovable for years, nay, scores of years, over the same regions. Such excessive sluggishness is not countenanced by observation.‡

The change in the appearance of the dark spots of the planet was first recognised by Secchi, in 1858.§

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* *H. and E.*, 1889.

† As if solar heat were desiccating vegetation on the planet.

‡ We have pointed out that the yellow Martian clouds may cover some districts for months (*Mars Reports*, for 1907, pp. 68–69, 88, and 90 ; and for 1909, pp. 34–38, &c.) ; but it is inadmissible that they may last for many years over a given marking.

§ *Osservazioni di Marte*, 1858.

In order to calculate the height of the projections, the following graphic method may be used :—

Let C (Fig. 18) be the centre of Mars, LTO one part of its

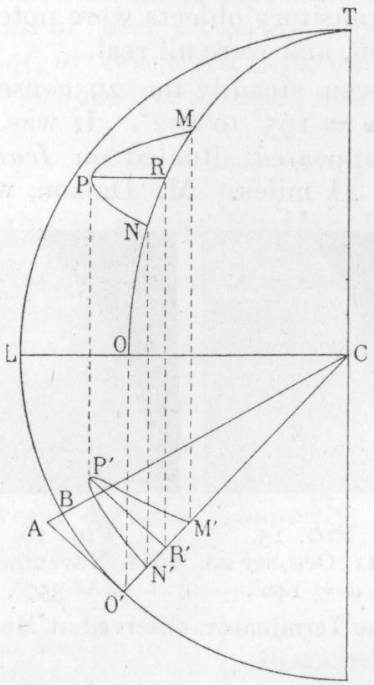

FIG. 18.

dark hemisphere turned towards the observer, $TMRNO$ the terminator, OL the greatest defect of illumination, MPN the bright projection as drawn at the telescope (exaggerated in size here, for the sake of clearness), and RP, parallel to CO, the protrusion of the marking.

Now conceive this eighth of the Martian globe to revolve downwards by 90° round COL, taken as an axis. Then T will coincide with C, and O will fall at O'. Join O' to C, and CO' will be the projected terminator. MRN, base of the prominence, will fall on $M'R'N'$; and, as the solar rays are normal to the terminator, P will be projected at P', on $R'P'$, perpendicular to CO'.

From O', draw the tangent $O'A = R'P'$, and join A with C. Then B is the point where the secant AC cuts the surface of the globe ; and AB is the true height, h, of the protuberance above the soil of Mars.

But

$$h = \text{sec. } O'B - 1 ;$$

or

$$h = \frac{1}{\text{cos. } O'B} - 1.$$

A protractor will give the value of $O'B$.

The radius of Mars is 2,100 miles ; and a table of natural cosines will thus enable the observer easily to compute the height of any projection on the terminator.

to S. Fig. 19 will give an idea of the extension and recession of this extraordinary display of the Martian atmosphere.

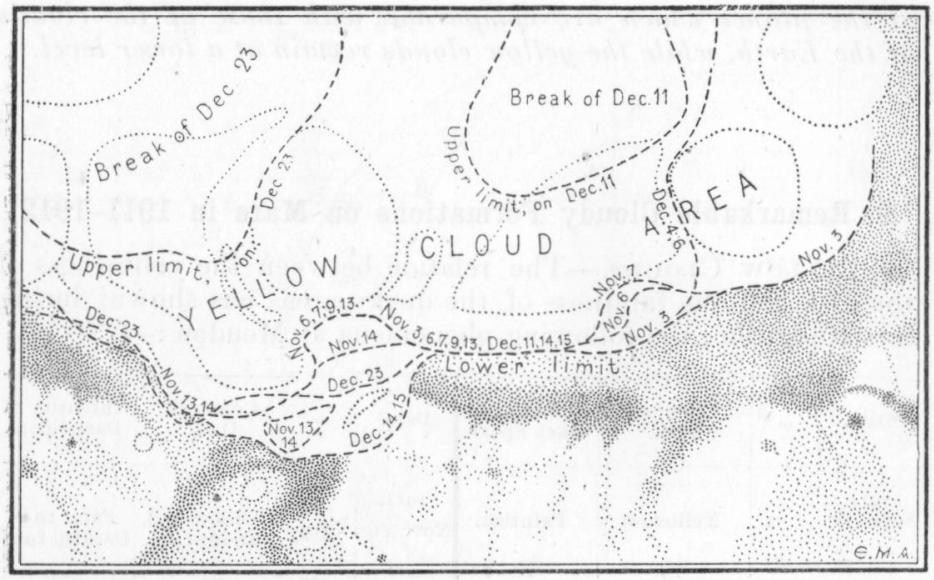

FIG. 19.—The great Yellow Cloud formation and its changes, as seen on Mars at Meudon, from November 3 to December 23, 1911.

On December 7 and January 7, McEwen noticed that, "although the image was good, Mars had a veiled appearance."

Argyre was again yellow in the 32¾-in. on January 13.

It is also noteworthy that *Pandoræ Fretum*, which was invisible in 1907, and so dark in 1909,* was again exceedingly faint or invisible throughout the apparition of 1911–1912.

Yellow cloud interposed itself over the N. snows also, on November 14, December 4, 6, 11, 14, 15, and 23. At Meudon, on December 14, the N. cap was lemon-coloured to left, white to right. And on 1912, February 2, the same cap was "very light "ochre" to McEwen.

WHITE CLOUDS.—A most unusual phenomenon took place in the region to the E. of *Syrtis Major*. On October 10, the Director, using the 8½-in. Calver, saw white, on the limb, the central part of *Ausonia*. On the following day, with the 32¾-in., he found *Libya* very bright, when risen, and covered with a host of white flocculi. On the same day, Phillips and Stanley Williams were struck by the "amazing development of cloud "over *Libya*." But, on October 14, at Meudon, the large telescope showed steadily, under $\omega = 181^\circ$ to 195°, a huge white cloud mass, which was so thick as to blot out completely *Mare Tyrrhenum*, a great part of *Hesperia*, and the N.W. end of *Mare Cimmerium!* There was, in addition, an isolated, irregular white patch S. of *Cerberi Sinus* (Fig. 20). "With your "observation of *Hesperia* and the W. part of *Mare Cimmerium* "being veiled by cloud on October 14," says Stanley Williams, "we have another good illustration of the presence of really

* See *Mars Reports* for these apparitions.

" dense cloud upon Mars.* But how much more frequent must " be the existence of a slight haze ! though a very slight haze " might greatly influence the appearance of the markings."

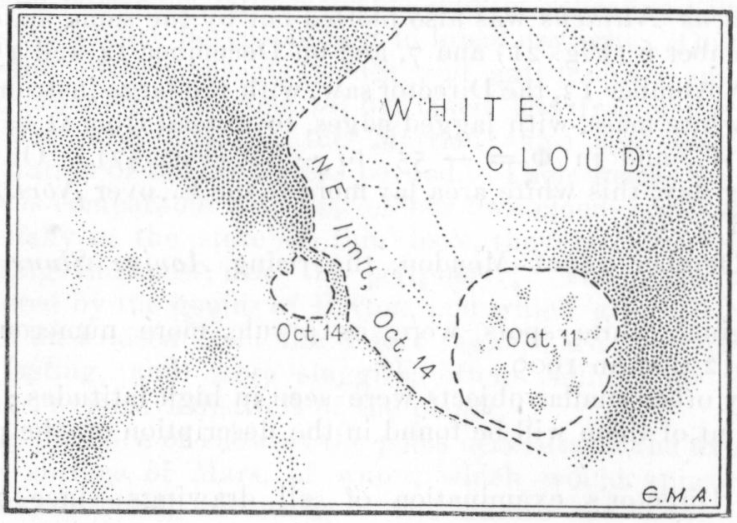

FIG. 20.—The great White Cloud area of 1911, over the *Mare Tyrrhenum* region, and its changes, as observed at Meudon on October 11 and 14.

Also, " I think," writes Phillips, " the cloud you refer to as " lying over the region of *Mare Tyrrhenum* on the 14th must " have been the same as the one I saw over *Libya* on the 11th." This seems so ; and the S.E. drift may be accounted for by the assumption that the cloud mass was carried by an anti-trade wind, blowing from the equator of Mars into southern latitudes, and undergoing the deflection to the right, or left on the inverted image.

Another important white cloud formation in 1911 was that which entirely concealed *Mare Acidalium* and, occasionally, *Lacus Niliacus* also. These two dark areas were well visible

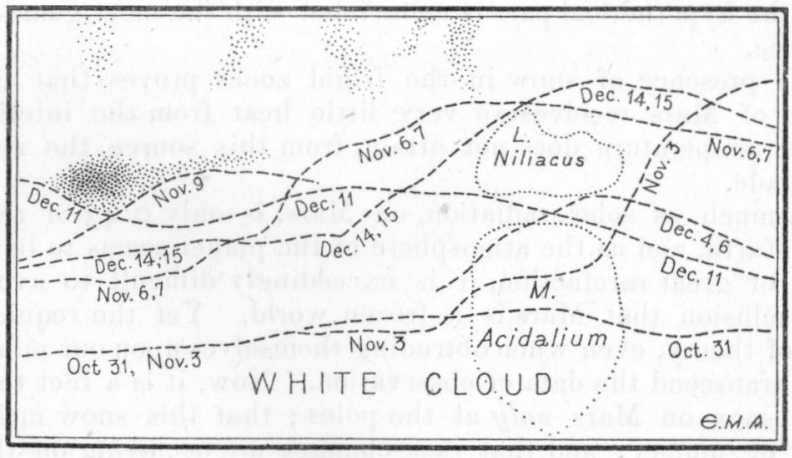

FIG. 21.—*Lacus Niliacus* and *Mare Acidalium*, blotted out by white cloud in 1911. (The Director, $32\frac{3}{4}$-in.)

* From 1911, October 10 to 14, Mars was in heliocentric longitude 36° to 39°. When Stanley Williams observed a similar white cloud area near the same region, in 1894, the planet was in longitude 26° ±.

These various data lead to the following general inference :—

The surface of Mars is very probably liable to be affected by changes of a local character, consisting in the more or less temporary darkening of grey or ruddy regions, usually in the immediate vicinity of, or connected with, one of the dark areas.

Some of these changes are secular, others recurrent, others seasonal.

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7. Stability of the Martian Detail.

The general stableness of the dusky spots has been established long ago ; but the permanent character of the minor irregularities was questioned until recent times. In the 1909 Report, p. 32, the Director has expressed his conviction that " a great many small details of the surface show a remarkable " stability," and based his argument on the fact that some of the minute spots detected with the $32\frac{3}{4}$-in. had already been seen by others several decades previously. This constancy is illustrated by the following table :—

Small Spots seen at Meudon in 1909 and 1911.		Discoverer.	Date of Discovery.	Years of Visibility.
1909.	*Eosphori Lacus*	Lowell	1907	4
1911.	*Nix Atlantica*	Molesworth	1898	13
1909.	*Corri Lacus*	do.	1896	13
1909.	*Noctis Lacus*	do.	1896	13
1911.	*Cerberi Lacus*	do.	1896	15
1911.	*Cancri Portus*	do.	1896	15
1911.	*Lucis Portus*	Lowell	1894	15
1909.	*Hydræ Palus*	do.	1894	15
1909.	*Bathys Portus*	do.	1894	15
1911.	*Semiramidis Lacus*	Schiaparelli	1890	21
1911.	*Astaboræ Fons*	do.	1890	21
1911.	*Cyclopum Sinus*	Trouvelot	1884	27
1911.	*Cerberi Sinus*	do.	1884	27
1909.	*Nectaris Fons*	Green	1877	32
1909.	*Incurva Insula*	do.	1877	32
1911.	Duplicity of *Portus Sigeus*	do.	1877	34
1911.	*Sirbonis Palus*	Schiaparelli	1877	34
1911.	Whiteness of *Candor*	Holden	1877	34
1911.	Duplicity of *Sinus Furcosus*	Dawes	1864	47
1911.	*Yaonis Fretum*	Lockyer	1862	49

Were the telescopes of the early observers more powerful, the visibility of such minute markings would have extended over a greater number of years. Hence, apart from the obliterating effect of cloud on the planet,

A very considerable number of small details of the surface of Mars remain unaltered in position and appearance.

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8. Projections on the Terminator.

Four of these transitory objects were noted with the $32\frac{3}{4}$-in. during the apparition, and were all real.

The first was seen steadily for 29 consecutive minutes, on 1911, October 14, $\omega = 195^\circ$ to 202°. It was of a very brilliant white colour, and appeared situated on *Icaria* (Fig. 14); and its height attained $4\frac{1}{2}$ miles. M. Dalzon, who was observing

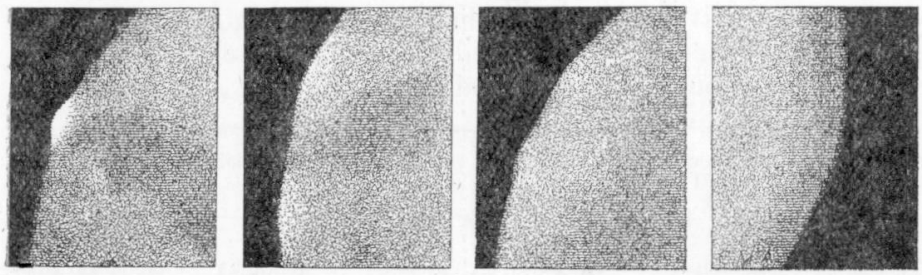

FIG. 14. 1911, October 14. $\omega = 195^\circ$.
FIG. 15. 1911, October 20. $\omega = 140^\circ$.
FIG. 16. 1911, November 3. $\omega = 357^\circ$.
FIG. 17. 1912, January 13. $\omega = 70^\circ$.

Projections from the Terminator, observed at Meudon in 1911–1912.

with the Director at the time, also saw this marking quite easily. The observation was unfortunately stopped by earthly cloud at $23^h\ 25^m$.

On October 20, at $21^h\ 35^m$, two slightly whitish protuberances were seen on *Thaumasia*, N.E. and S.E. of *Solis Lacus* (Fig. 15). Height = $1\frac{1}{2}$ mile for the N. hump, $3\frac{1}{2}$ miles for the S. one.

On November 3, at $21^h\ 48^m$, there were two slight bulges over *Hellas*, which was of a dull whitish tinge (Fig. 16). Height of the N. prominence = $4\frac{1}{2}$ miles; of the S. one = $3\frac{1}{2}$ miles.

Lastly, on 1912, January 13, at $21^h\ 0^m$, *Tharsis* appeared covered with yellow material, protruding some 2 miles beyond the terminator (Fig. 17).

The first of these projections was probably due to bright cirrus cloud on Mars; the two humps of October 20, as well as those of November 3, to slight haze, floating at a lesser altitude; whereas the bulge of January 3 was obviously produced by yellow clouds, which do not seem to rise as high as the white ones, since the large protuberances are always white.

Considering that no projections were hitherto seen with certainty on the limb, the heights of these humps were calculated after the views expressed by Prof. Campbell in 1894.* We have thus assumed the objects to extend beyond the terminator, and, owing to their height, to receive sunlight, while the adjoining districts are cast in darkness.

* *Publ. Astr. Soc. Pacific*, 1894, p. 103.

In order to calculate the height of the projections, the following graphic method may be used :—

Let *C* (Fig. 18) be the centre of Mars, *LTO* one part of its

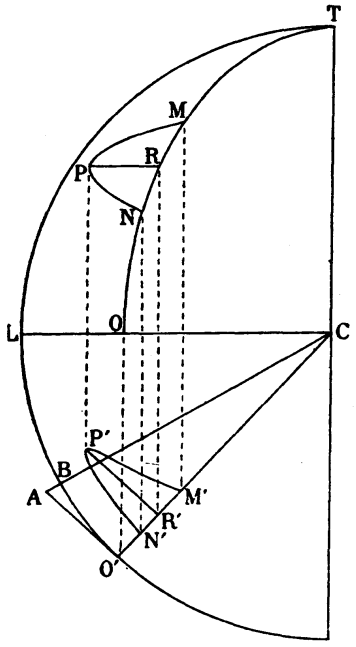

FIG. 18.

dark hemisphere turned towards the observer, *TMRNO* the terminator, *OL* the greatest defect of illumination, *MPN* the bright projection as drawn at the telescope (exaggerated in size here, for the sake of clearness), and *RP*, parallel to *CO*, the protrusion of the marking.

Now conceive this eighth of the Martian globe to revolve downwards by 90° round *COL*, taken as an axis. Then *T* will coincide with *C*, and *O* will fall at *O'*. Join *O'* to *C*, and *CO'* will be the projected terminator. *MRN*, base of the prominence, will fall on *M'R'N'*; and, as the solar rays are normal to the terminator; *P* will be projected at *P'*, on *R'P'*, perpendicular to *CO'*.

From *O'*, draw the tangent $O'A = R'P'$, and join *A* with *C*. Then *B* is the point where the secant *AC* cuts the surface of the globe; and *AB* is the true height, *h*, of the protuberance above the soil of Mars.

But

$$h = \text{sec. } O'B - 1;$$

or

$$h = \frac{1}{\text{cos. } O'B} - 1.$$

A protractor will give the value of *O'B*.

The radius of Mars is 2,100 miles; and a table of natural cosines will thus enable the observer easily to compute the height of any projection on the terminator.

From these observations we gather the following inference :—

The white clouds of Mars float at heights above the surface of the planet which are comparable with those of the clouds of the Earth, while the yellow clouds remain at a lower level.

9. Remarkable Cloudy Formations on Mars in 1911–1912.

YELLOW CLOUDS.—The relation between the yellowness of the disk and the faintness of the dusky areas has shown, during this apparition, the following phenomena at Meudon :—

Date.	ω	Colour of Disk.	Intensity of Dark Spots.	Date.	ω	Colour of Disk.	Intensity of Dark Spots.
1911.	°			1911.	°		
Sept. 18	71	Yellowish	Faintish.	Nov. 6	319	Yellow to S. Ruddy to N.	Faint to S. Darkish to N.
„ 23	85	do.	do.	„ 6	337	do.	do.
„ 23	23	do.	do.	„ 7	321	do.	do.
„ 25	3	do.	do.	„ 9	292	do.	do.
„ 29	333	Yellow	do.	„ 13	262	Lemon yellow	Faintish.
Oct. 10	213	Ruddy	Darkish.	„ 13	282	Yellow	do.
„ 11	216	Yellowish	do.	„ 14	255	Lemon yellow	Majority of spots faint.
„ 14	167	Yellow	do.	Dec. 4	87	A bit yellow	Darkish.
„ 14	181	Yellowish	Faintish.	„ 6	62	do.	do.
„ 14	195	do.	do.	„ 11	8	do.	Dark.
„ 17	152	Ruddy	Darkish.	„ 14	343	Yellowish	Darkish.
„ 20	140	A bit yellow	do.	„ 15	331	A bit yellow	Almost dark.
„ 28	58	Ruddy	do.	„ 23	259	do.	Darkish.
„ 31	27	Yellow	Faintish.				
Nov. 3	357	Yellow to S. Ruddy to N.	Faint to S. Dark to N.	1912. Jan. 13	70	Yellow	Faintish.

Between November 3 and December 23, an immense yellow cloud area of some 8,000,000 square miles stretched from the S. pole to *Argyre*, down to *Deucalionis Regio*, *N. Ausonia*, and beyond *Mare Tyrrhenum*, almost blotting out *Noachis* and *Hellas*. The veil, as seen with the great refractor, measured more than 5,000 miles from E. to W. On November 13 and 14, an isolated yellow patch, independently seen by Phillips and the Director, jutted out from *Libya* towards *Hammonis Cornu*. By December 4, *Argyre* had already recovered its red colour ; and, a week later, S. *Hellespontus* looked dark. Lastly, another shrinkage of the yellow mass occurred on December 23, when the S. part of *Ausonia* was disclosed to view with its fiery soil, while the adjoining *maria* appeared very dark indeed. On December 14, 15, and 23, *Syrtis Major* was itself slightly veiled

to S. Fig. 19 will give an idea of the extension and recession of this extraordinary display of the Martian atmosphere.

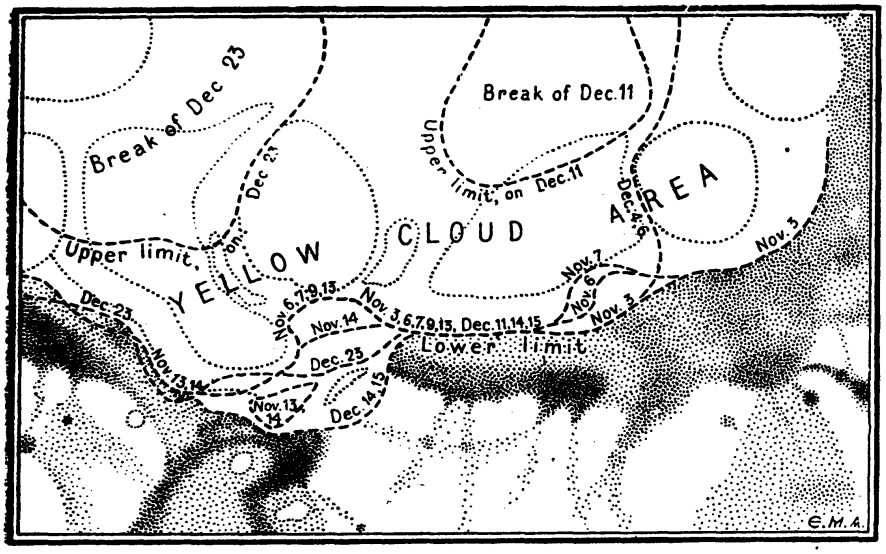

FIG. 19.—The great Yellow Cloud formation and its changes, as seen on Mars at Meudon, from November 3 to December 23, 1911.

On December 7 and January 7, McEwen noticed that, "although the image was good, Mars had a veiled appearance."

Argyre was again yellow in the $32\frac{3}{4}$-in. on January 13.

It is also noteworthy that *Pandoræ Fretum*, which was invisible in 1907, and so dark in 1909,* was again exceedingly faint or invisible throughout the apparition of 1911–1912.

Yellow cloud interposed itself over the N. snows also, on November 14, December 4, 6, 11, 14, 15, and 23. At Meudon, on December 14, the N. cap was lemon-coloured to left, white to right. And on 1912, February 2, the same cap was "very light "ochre" to McEwen.

WHITE CLOUDS.—A most unusual phenomenon took place in the region to the E. of *Syrtis Major*. On October 10, the Director, using the $8\frac{1}{2}$-in. Calver, saw white, on the limb, the central part of *Ausonia*. On the following day, with the $32\frac{3}{4}$-in., he found *Libya* very bright, when risen, and covered with a host of white flocculi. On the same day, Phillips and Stanley Williams were struck by the "amazing development of cloud "over *Libya*." But, on October 14, at Meudon, the large telescope showed steadily, under $\omega = 181°$ to 195°, a huge white cloud mass, which was so thick as to blot out completely *Mare Tyrrhenum*, a great part of *Hesperia*, and the N.W. end of *Mare Cimmerium!* There was, in addition, an isolated, irregular white patch S. of *Cerberi Sinus* (Fig. 20). "With your "observation of *Hesperia* and the W. part of *Mare Cimmerium* "being veiled by cloud on October 14," says Stanley Williams, "we have another good illustration of the presence of really

* See *Mars Reports* for these apparitions.

" dense cloud upon Mars.* But how much more frequent must " be the existence of a slight haze ! though a very slight haze " might greatly influence the appearance of the markings."

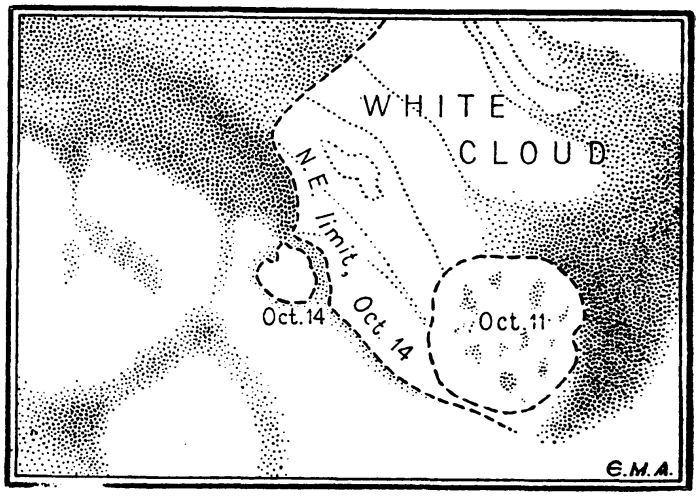

FIG. 20.—The great White Cloud area of 1911, over the *Mare Tyrrhenum* region, and its changes, as observed at Meudon on October 11 and 14.

Also, " I think," writes Phillips, " the cloud you refer to as " lying over the region of *Mare Tyrrhenum* on the 14th must " have been the same as the one I saw over *Libya* on the 11th." This seems so ; and the S.E. drift may be accounted for by the assumption that the cloud mass was carried by an anti-trade wind, blowing from the equator of Mars into southern latitudes, and undergoing the deflection to the right, or left on the inverted image.

Another important white cloud formation in 1911 was that which entirely concealed *Mare Acidalium* and, occasionally, *Lacus Niliacus* also. These two dark areas were well visible

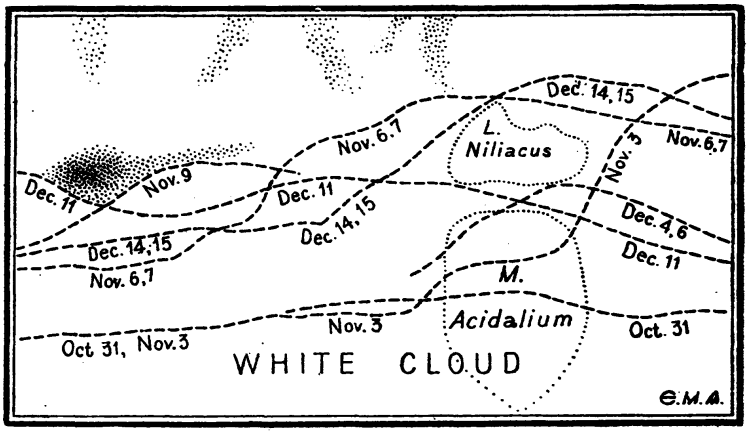

FIG. 21.—*Lacus Niliacus* and *Mare Acidalium*, blotted out by white cloud in 1911. (The Director, 32¾-in.)

* From 1911, October 10 to 14, Mars was in heliocentric longitude 36° to 39°. When Stanley Williams observed a similar white cloud area near the same region, in 1894, the planet was in longitude 26° ±.

at Meudon on October 31. But, from November 3 to December 15, *Mare Acidalium* remained covered with an extension of the white cloud masses of the N. polar regions; while *Lacus Niliacus* was also blotted out by the same material on November 6 (Fig. 21) and 7, and on December 14 and 15.

On November 13, the Director saw, with the large instrument, a great white mass, with jagged edges, to extend from $\Omega = 340^\circ$ and to W., and in $\Phi = -55^\circ$ to -82° (Fig. 57). On the following day, this white area lay more to the E., over *Novissima Thyle* (Fig. 58).

On October 28, at Meudon, the rising *Aonius Sinus* was whitish.

Marginal white spots were, as a rule, more numerous in 1911–1912 than in 1909.

Many other similar objects were seen in high latitudes; and an account of them will be found in the description of the polar regions.

The Director's examination of all drawings since 1856 establishes that—

I. *White cloud forms more readily over the yellow ochre than over the dusky areas;* and that

II. *The N. frigid zone of Mars is much more frequently, and much more extensively, covered with white cloud than the S. one.*

GREY CLOUDS?—As noted in the last Report, pp. 37 and 48, *Deucalionis Regio* was sometimes red, sometimes grey, in 1909. The same phenomenon was seen with the $32\frac{3}{4}$-in. in 1911. Volcanic dust?

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10. Speculations on the Physical Condition of Mars.

Terrestrial analogies lead us to the following conclusions, of which the hypothetical part is enunciated with the most guarded diffidence.

The presence of snow in the frigid zones proves that the surface of Mars receives so very little heat from the interior that its temperature does not attain, from this source, the zero Centigrade.

Inasmuch as solar radiation, on Mars, is only 0·43 of that on the Earth, and as the atmosphere of the planet seems to be in a state of great rarefaction, it is exceedingly difficult to avoid the conclusion that Mars is a frozen world. Yet the requirements of theory, even when obtruding themselves upon our mind, cannot transcend the data of observation. Now, it is a fact that we see snow on Mars *only* at the poles; that this snow melts rapidly in summer; and that vast changes are occurring on the superficies of the planet. Phenomena like these seem best accounted for by the assumption that the mean temperature of Mars is above the freezing point of water, and almost comparable with that of the Earth. But, at the distance of our neighbour in space, such a condition could be realized only by a gaseous envelope greatly diathermanous to the luminous heat of the

Sun* and fairly athermanous to the dark heat reflected from the surface.†

The atmosphere of Mars is extremely transparent: its absorbing power for light is feeble, and its reflective power nil. Hence stars must be visible in it in broad daylight. On a small scale, the planet has its trades and anti-trades; and white clouds, probably analogous to, but much less frequent or dense than, our own, float in the Martian skies and distort the configuration of the dark areas beyond. Their height above the surface is comparable with that of our own clouds; and, as they are usually in the state of thin haze, they brighten, through increasing thickness, near the periphery.‡ The yellow clouds, discovered by the genius of Burton, and which are probably due to sand dust raised from the desert regions, are more frequent, more lasting, and more sluggish, often veiling, for months together, extensive districts of the planet.

The presence of snow at the poles necessitates the existence, on the surface of Mars, of water, which would appear grey, greenish, or black, according to the nature and depth of the bottom. The lawn-green areas are probably due to vegetation.§ The vast ruddy expanses have the colour of sandy deserts,‖ in which we discover many complex, dusky irregularities, often showing a tendency to winding, streaky agglomeration, and apparently corresponding to our valleys.¶

Change in the outlines of the greenish marks may be accounted for by the growth and decay of vegetation.**

Mars may thus still be inhabited, although having certainly reached the stage of decrepitude in planetary life.

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* E. W. Maunder, *Knowledge*, 1892, p. 168.

† John Phillips, of Oxford, *Pr. Royal Soc.*, 1865, pp. 42–46.

‡ *Mars Report* for 1907, pp. 69-70.

§ Liais, in *Mém. sur Mars* by Cruls, Rio-de-Janeiro, 1878.

‖ *Ibid.*

¶ Penard, *L'Astronomie*, 1888, p. 384.

** Liais, *l.c.* Areography owes much to the sound views expressed by this distinguished French astronomer.

PART II.

THE OBSERVATIONS.

The following abbreviations are used in this Report :— Ω = areocentric longitude, reckoned from *Fastigium Aryn* rightward ; Φ = areocentric latitude ; ω = longitude of the centre of the disk ; ϕ = latitude of the same ; N. = North ; S. = South ; E. = Areographic East (West, or left, for the observer) ; W. = Areographic West (East, or right, for the observer) ; *p.* = preceding ; *f.* = following ; C.M. = central meridian of the disk ; η = Heliocentric longitude of Mars.

The dates are invariably given in G.C.M.T.

The dimensions of the minor details are given in equatorial degrees of the planet.

Reference to the Chart (Plate III.) will render clearer the following analysis.

SECTION I.

Sinus Sabæus.

$\Omega = 310^\circ$ to 10° ; $\Phi = -60^\circ$ to $+60^\circ$.

HELLESPONTUS appeared almost always more or less veiled in 1911–1912, when yellow cloud was prevalent here. The drawings of Backhouse, McEwen, O'Hara, Phillips, Price, Thomson, and of the Director, show this "channel" faintish on September 5 ; invisible, through yellow cloud, on September 29 and October 8 ; faint on November 3 ; darkish on November 6 ; faintish on November 7 ; rather faint on November 8, and especially in $\Phi = -40^\circ$; darkish, though interrupted, in $\Phi = -45^\circ$, on November 9 ; twice areolated in $\Phi = -40^\circ$ and -50° on November 14 ; dark at the ends, and especially to S.W., on December 11 (Plate I., Fig. 1) ; very faint on December 12, 14, and 15 ; darkish all along on December 19 ; veiled in two parts, and knotted, on December 22 ; and darkish on January 19. McEwen speaks of the "distinct light Van "Dyke brown" colour of this broad stripe, on October 4.

NOACHIS remained generally confused, on account of the faintness of *Hellespontus* and *Pandoræ Fretum*, when the yellow atmospheric element concealed the subjacent features in these regions. According to the Director, it was ruddy on October 31 ; yellow on November 3, 6, and 7 ; a bit ruddier on November 9 ; still ruddier, when S. *Hellespontus* looked darker, on December 11 ; and orange on December 14 and 15.

From the joint data of Backhouse, McEwen, and the Director, we glean that *Noachis* appeared white, when rising, on October 5 ; that it was bright, when setting, on December 4, 5,

6, and 11 ; very bright, near sunset, on January 7, 14, and 19 ; and white, when rising on the terminator, on February 23.

PANDORÆ FRETUM, so faint in 1907, and so dark in 1909, was again virtually invisible in 1911–1912. Phillips justly remarks that it had "faded greatly since 1909," and that it was "very much narrower and less conspicuous." This is in full accordance with the experience of Thomson and of the Director ; and on November 3 and 6, the "channel" was utterly invisible in the Meudon refractor.

VULCANI PELAGUS is the name here given to the *mare f. Pandoræ Fretum.* which M. Quénisset and others saw rising to S.W. in 1909.* This mark was less veiled than the *Fretum* to E., in 1911, having been drawn darkish by the Director on October 31, November 3, 6, and 7 ; by Phillips on November 9 ; by Thomson on December 11 ; and again by the Director on December 11 (Plate I., Fig 1), 12, 14, and 15.

BARATHRUM displayed nothing abnormal during the apparition.

DEUCALIONIS REGIO had its usual cigar-shaped form, bending to N. at right angles on *Thymiamata*, according to Phillips, Thomson, and the Director (Fig. 22, and Plate I., Fig. 1). Its E. extremity, *Scylla et Charybdis*, was generally easy. It was, as usual, duskier than the "continent" to the N., and its colour was described "Saturn red" by McEwen on November 6 and 8, and "Venetian red" on December 9. In 1888, Schiaparelli called attention to the fact that this "land" appears sometimes red, sometimes grey,† and this curious phenomenon was fully confirmed, in 1909 and in 1911, with the $32\frac{3}{4}$-in. Thus *Deucalionis Regio* looked ruddy, at Meudon, on 1911, October 31, and on November 3 ; it then turned grey on November 6, 7, and 8, and was still greyish on December 11, 14, and 15.‡

The "island" was whitish, when risen, on November 14, in the large refractor.

SINUS SABÆUS, winding, as usual, is broad on the drawings of Backhouse, McEwen, O'Hara, and Price ; moderately wide on those of Thomson (Plate II., Fig. 6) and of the Director ; and narrowish on the sketches of Phillips. McEwen saw the *Sinus* generally brown, but "dark Delft blue" on November 6. In the $32\frac{3}{4}$-in., it looked bluish-grey, not greenish, on December 11. Its intensity was always considerable to all Members, the marking appearing, with *Sinus Furcosus*, the darkest spot of the surface between $\Omega = 300°$ and 50°. As in 1909, the darkness was greatest along the "coast" of *Aeria*. McEwen refers to the visibility of *Xisuthri Regio*, on November 6 and 8,

* *Mars Report*, 1909, p. 47.
† *H. and E.*, 1889.
‡ *See* p. 126.

when no trace of that "island" could be descried in the large telescope. According to the drawings of Backhouse, O'Hara,

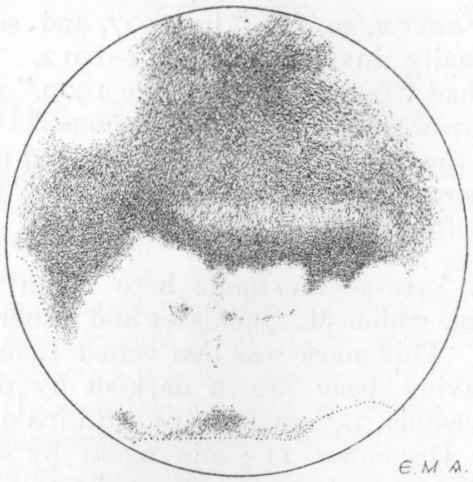

FIG. 22.—The *Sinus Sabæus* region of Mars. 1911, December 15, $\omega = 331°$. (The Director.)

Thomson, and the Director, the only dates on which *Sinus Sabæus* might have been faintish in 1911–1912, were those of September 5, 23, 25, 29, and December 22.

PORTUS SIGEUS looked always forked in the $32\frac{3}{4}$-in (Fig. 22). Undoubtedly, this "bay" is permanently double. Its general concavity was successfully made out by Backhouse, McEwen, Phillips, Thomson, and by the Director with the $8\frac{1}{2}$-in. The object was dark throughout the apparition.

SINUS FURCOSUS appeared normal in 1911–1912. Its prongs were caught by McEwen, Phillips, Thomson, and the Director, and were always easy under good seeing in the great equatorial. As usual, the E. edge of the *p.* prong ran parallel to the meridian, and the whole "bay" was large and trending to S.W. in the $32\frac{3}{4}$-in. (Fig. 22). McEwen found the *Sinus* "very dark Delft blue" on November 6, and "raw umber" on January 19. It was often the darkest marking on the disk, rivalling the N. part of *Syrtis Major;* and the dates of September 23, 25, and 29 constitute the only occasions on which it might have been a little obliterated at Meudon.

FASTIGIUM ARYN was clearly detected, under good definition, by McEwen, Phillips, Thomson, and the Director, when it did not look shaded. However, it was more difficult than in 1909. On December 11, under rippling images, it seemed "bridged" to *Deucalionis Regio* in the big telescope.

THYMIAMATA was shaded, in the $32\frac{3}{4}$-in., on November 3 and December 14. McEwen speaks of its "brown ochre tint" on January 19.

It assumed, at Meudon, the appearance of a marginal glare when rising on November 9, and also near sunset on December 4. McEwen found it "almost white" on the limb on February 20.

EDOM PROMONTORIUM rises considerably to S. on the drawings of McEwen, Phillips, Thomson, and of the Director. According to these observers, it looked whitish on November 6, 9, December 11 and 14. Quivering air in the $32\frac{3}{4}$-in., caused sometimes this "cape" to expand, and momentarily to strangle *Sinus Sabæus*.

EDOM appeared "deep Saturn red" to McEwen on November 6, "gold ochre" on November 8, "very light ochre" on November 9, and "brown ochre" on January 19. This region was "ruddy," at Meudon, on November 3, 6, 7, 9, and on December 11. Moreover, the whole district between the *Hiddekel* and the *Gehon* was shaded to the Director on November 3, and to McEwen on January 19.

AERIA, generally ruddy to McEwen, was very red in the $32\frac{3}{4}$-in., on November 3, 6, 7, 9, and on December 11, 14, and 15.

McEwen found it bright, after sunrise, on October 9, and on December 22.

HAMMONIS CORNU, blunted to Backhouse, McEwen, O'Hara, and Price, comes out more hooked on the drawings of Phillips and Thomson. As in 1909, the large instrument, under propitious circumstances, gave it almost the outline of the beak of a parrot.

ARABIA looked very often red in 1911. McEwen described it as "remarkably ruddy" on October 10, "dark vermilion" on November 8, and "burnt yellow" on the following day. To the Director, it was red on November 6, 7, and 9; and, on the last-named date, the district W. of the *Phison* displayed a delicate half-tone.

Arabia set brightish at Meudon on December 11.

EDEN, shaded as far as *Aryn*, in the $32\frac{3}{4}$-in., on November 3, and to McEwen on January 19, was "dark vermilion" to the latter on November 8.

Eden rose bright, to the Director, on November 13.

SIRBONIS PALUS had the appearance of a diffused smudge, in the $32\frac{3}{4}$-in., on November 6, 9, and December 15 (Fig. 22).

SEMIRAMIDIS LACUS was glimpsed as a dusky speck at Meudon on November 6 and on December 15.

ARETHUSA FONS has a diameter of 15° on McEwen's drawing of January 19.

ISMENIUS LACUS appeared "very dark sepia" to McEwen on November 9. Short views of this steel grey "lake" were had by the Director, in the $32\frac{3}{4}$-in., on November 6, 9, December 11 and 15.

DIOSCURIA, bluish to O'Hara on October 8, seemed slightly shaded to Phillips and to the Director. Its N. part was almost invariably covered by the white material of the pole; and, on December 11, this bright area stretched as far as the N.E. edge of *Lacus Ismenius* (Plate I., Fig. 1).

CYDONIA rose bright, on November 9, in the great instrument.

MINOR DETAIL.

DEUTERONILUS.—The Director: November 6, to E. only, width 3°, darkish.

EUPHRATES.—Phillips: November 9, 14, to S. only, "very soft and hazy "streak," 3° wide, faint; December 20, to S. only, "soft and hazy."—Thomson: December 11, width 3½°, faint; December 19, "glimpsed"; December 22, width 3½°, faint; January 26, "seen."—The Director: October 31, glimpsed to S. only, 12° wide near the limb; November 3, glimpsed to S. only, 7° wide, faint; November 6, 9, 11, width 5°, diffused; December 14, 15, to S. chiefly, width 6°, very faint.

GEHON.—McEwen: August 27, width 3°, edge of shaded area to E.; November 6, width 4°, to S. only, darkish.—Thomson: December 11, to S. only, convex to N.E., 3° wide, faint; to N., edge of shade in *Eden;* December 12, do., 2° wide, edge of shade to E.—The Director: September 25, in 8½-in., convex to E., 3° wide to S., 7° to N., faintish; September 29, in 32¾-in., convex to E., 3½° wide to S., 10° to N.W.; November 3, to S. only, width 6°, smudgy, glimpsed for $\frac{1}{6}$ second; December 11, convex to E., mean width 5°, faint; December 14, convex to E., narrower to S. than to N.W., edge of shaded *Thymiamata.*

HIDDEKEL.—McEwen: August 27, width 2°, edge of shade to W.; November 6, straight, width 3°, darkish; January 19, width 5°, faint.—Thomson: December 11, to S. only; December 12, convex to N.W., 2° wide, faintish, edge of shade to W.—The Director: November 6, convex to N.W., 4° wide, very faint.

NEUDRUS.—The Director: October 31 and December 11, width 7½°, faint (Plate I., Fig. 1).

ORONTES.—McEwen: November 6, width 3°, faint.—Phillips: November 9, width 3°, exceedingly faint.—The Director: November 3, 6, 11, 15, glimpsed, concave to S., mean width 4°, very faint and diffused.

PHISON.—Phillips: October 8, width 7°, very faint; November 9, to S. only, width 7°, exceedingly faint and diffused, "very soft and hazy "streak"; December 20, "traced as far as its junction with *Astaboras,* "but not beyond."—Thomson: December 11, S. end only, 3° wide; December 19, probably glimpsed; December 22, from *Astusapes* to S. only, 2° wide, faint; January 26, "seen."—The Director: November 6, 9, 13, slightly winding, mean width 5°, edge of shade to N.W., very faint.

PROTONILUS.—McEwen: November 9, "very dark sepia."—Phillips: always as the S. limit of the N. polar shadings.—Thomson: always as the S. limit of N. polar white area.—The Director: November 6 and 9, width 4°, undulating, darkish.

TYPHONIUS.—Phillips: November 10, E. end seen; November 14, width 4°, very faint.—The Director: November 6, convex to S., 3° wide, very faint.

SECTION II.

Mare Erythræum, Margaritifer Sinus, Auroræ Sinus, and Mare Acidalium.

$\Omega = 10°$ to $70°$; $\Phi = -60°$ to $+60°$.

ARGYRE I., according to the Meudon data, has a more easterly position on our present Chart than on the one for 1909. Confuse, as a rule, on the delineations of Backhouse, McEwen,

Phillips, and Thomson, it was somewhat better outlined in the $32\frac{3}{4}$, under indifferent seeing conditions. On October 31, at Meudon, this "land" appeared irregularly oval, with bulges to N.W. and S.E., and with *Horarum* and *Charitum Promontoria* blunted. In the large telescope, *Argyre* looked ruddy, yellowish, near the terminator on October 28; ruddy, on C.M., on October 31; yellow in November*: red, on the limb, on December 4; ruddy, near C.M., on December 6; ruddy again on December 11; and once more yellow on January 13.

According to the joint results of Backhouse, McEwen, Phillips, Thomson, and the Director, the "island" was "very "bright to S., but faint to N.," on September 21; not bright, on limb, on September 29; "very white," risen, on October 3; whitish, after sunrise, on November 3, 6, 9, and 10; bright, setting, on December 4; not white, rising, on December 14 and 15; whitish, near C.M., on January 14; "bright ochre," near the terminator, on January 19; and "intensely white," on the disk, on February 20 and 23. We infer that the marginal brightening of *Argyre I.* was not remarkable in 1911–1912.

ARGYROPOROS was visible only to N.W., on October 31, in the $32\frac{3}{4}$-in.; but it was easy on December 11.

CAMPI PHLEGRÆI, 1911, constituted a very striking object. On October 28, they had the form of a trapezoidal dusky mark, in the large instrument, and lay S.W. of *Argyre I.* and N. of *Argyre II.* The spot was held steadily, and its colour was grey. On October 31 and December 4, nothing was seen here; but, two days later, there appeared a vast U-shaped *brown* area

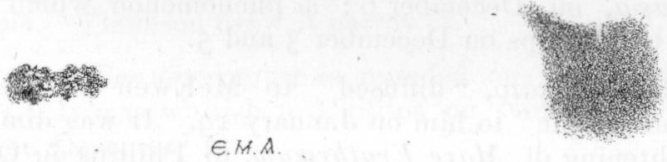

FIG. 23.—1909. FIG. 24.—1911.

Appearance of the intensely brown spots, *Campi Phlegræi*, *f. Argyre I.*, as seen at Meudon.

to the S.W. of *Argyre I.* (Fig. 24), which violently contrasted with the ordinary colours of the surrounding districts. Yet, on January 13, everything hereabout being yellow, there was no trace of the brown spot. With extraordinary acuteness, Phillips detected *Campi Phlegræi*, 1911, on December 3; but their brown colour was naturally beyond the reach of his instrument.

It is probable that this singular brown marking was not the same as the one discovered at Meudon in 1909,† which seemed to be more to the N., and whose general appearance, necessarily inaccurate in all its parts, is given in Fig. 23.

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* *See* p. 123. † *Mars Report* for 1909, p. 53.

A dark spot, caught with the $32\frac{3}{4}$-in., on 1911, October 28 and 31, may be identical with the *Campi Phlegræi* of 1909.

The brown colour of this object stamps it as different in nature from the dusky areas of Mars.

Ogygis Regio, a doubtful "island" in the great refractor, looked bright to McEwen on September 21, January 19, and February 20.

Depressio Erythræa is the name given to a considerable dusky mark seen with the large instrument to the N.N.W. of *Argyre I.*, on October 28, 31, December 4, 6, 11, and on January 13. Phillips was also successful in glimpsing a "dark patch *n.f. Argyre*" on November 6.

A dusky condensation hereabout is already shown in our 1909 chart.*

Mare Erythræum, always brownish to McEwen, looked distinctly varying in depth of tone and checkered, in the $32\frac{3}{4}$-in., on October 31. From the joint observations of Backhouse, McEwen, O'Hara, Phillips, Thomson, and the Director, we gather that this "sea" was faintish, as a whole, on August 17; that it was darkish on August 23 and 27; faintish again on September 23, 25, 29, October 1; darkish on October 28 and 31; faintish on November 3, 5, 6, 7, 8, December 4 and 5; darkish on December 6; faintish on December 7, 11, 12, 14, and 15, as well as on January 7; darkish on January 13 and 14; and once more pale on January 19 and on February 20.

Protei Regio is described "very faint but clearly visible," by McEwen, on December 4. Generally smudgy in the large instrument, it looked brightish, as a spur originating at *Thaumasia*, on December 6; a phenomenon which was also noticed by Phillips on December 3 and 5.

Pyrrhæ Regio, "diffused" to McEwen on December 9, was "prominent" to him on January 19. It was dimly defined, as a lightening of *Mare Erythræum*, to Phillips on October 28, November 6, and December 5. The Director found it angular and vague on October 28, 31, and December 6; confuse on December 11 and January 13.

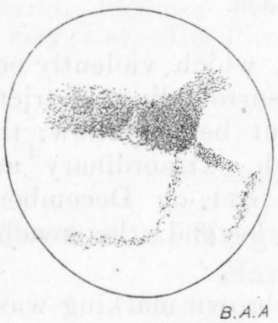

FIG. 25.—October 2, $\omega = 36°$ (O'Hara).

FIG. 26.—January 14, $\omega = 46°$ (McEwen).

The *Margaritifer Sinus* and *Auroræ Sinus* districts in 1911–12.

* *Mars Report* for 1909, Plate V.

looked faintish on December 11 ; darkish on December 12 ; was once more invaded by white cloud on December 14 and 15 ; looked faint on January 7 and 13 ; was again blotted out by white material on January 14 ; flashed forth "surprisingly "dark" on January 19 ; and was finally veiled by whitish cloud on February 20. These are unquestionable and remarkable changes !

ACHILLIS PONS was very vaguely glimpsed by the Director on October 31.

MARE ACIDALIUM suffered still more from the veils of the Martian atmosphere in 1911–1912. The drawings of the observers of *Lacus Niliacus* establish that it was rendered

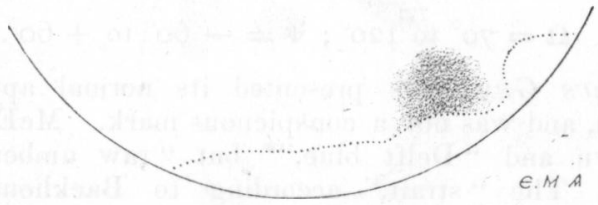

FIG. 27.—White cloud over *Mare Acidalium*. 1911, November 3, $\omega = 357°$. (The Director, $32\frac{3}{4}$-in.)

invisible by yellow material on August 23, September 23, 25, 29, October 1 and 2 ; that it was faintish on October 28 and 31 ; that it was almost completely masked by white cloud on November 3 (Fig. 27), 6, 7, 9, December 3, 4, 5, 6, 11, 12, 14, and 15 ; that it was faintish on January 7 and 13 ; that it was veiled by white material on January 14 ; that it looked dark on January 19 ; and that it was once more covered by white cloud on February 20. All these variations of appearance are real.

TEMPE was very bright to the Director on November 3.

MINOR DETAIL.

BÆTIS.—Phillips : December 3, 5, width 2°, dark.—Thomson : December 11, width 1°, dark.—The Director : October 28, 31, width $1\frac{1}{2}$°, darkish edge of shade to N.E. ; December 4, 6, width 1°, do. ; January 13, edge of shade to N.E.

GANGES.—McEwen : September 24, December 7, width 4°, faint, "diffused orange streak."—Phillips : October 28, conspicuous edge of shaded *Xanthe ;* October 29, width 6°, faintish ; December 3, 5, width $10\frac{1}{2}$°, faintish.—Thomson : December 11, width 3°, edge of shaded *Xanthe.*—The Director : September 18, width 5°, faint edge of shaded *Xanthe ;* October 28, width 3°, do. ; a second streak glimpsed 15° to E. ; October 31, December 4, 6, January 13, mere edge of shaded *Xanthe.*

HYDRAOTES.—Phillips : October 28, to N.W. only, mean width 5°, faint.—The Director : October 31, to N.W. only, wavy, 3° wide.

INDUS.—McEwen : November 6, straight, width 4°, dark, "Saturn red" ; January 19, to S. only, straight, 4° wide.—Phillips : November 6 and 9, convex to E., $2\frac{1}{2}$° wide, very faint.—Thomson : December 12, convex to E., 3° wide to S.E., 1° to N.W., faint to N.—The Director : September 25, in $8\frac{1}{2}$-in., convex to E., 4° wide, darkish ; October 31, in $32\frac{3}{4}$-in., convex to E., 5° wide, faint ; November 3, do., knotted ; December 6 and 11, do., $6\frac{1}{2}$° wide, by no means easy.

on November 3; darkish on November 6; dark to N. on December 3, 4, 5, 6, 7, 11, January 7 and 13; and darkish on January 14 and February 20.

CHRYSE rose white on September 29, November 6 and 7, in the great equatorial; and McEwen also described it very white, when setting, on January 14.

XANTHE was noted "shaded" by Phillips on October 28, when the superior light-grasp of the $32\frac{3}{4}$-in. revealed its *dingy brown* colour and consequent peculiar nature. A paler sepia tint was recorded here on December 6; but, on January 13, the brown area was so striking as to be visible at the first glance cast in the large instrument.

Xanthe rose whitish on September 25 to the Director.

HYDRÆ PALUS was glimpsed, at Meudon, on October 31.

JUVENTÆ FONS looked blackish in the $32\frac{3}{4}$-in., on October 28 and December 4; and, two days later, it was black. On December 3 and 5, Phillips depicted it as "dark as anything"; and, on December 11, Thomson noted here "a very dark spot," which "flashed forth suddenly into view." *Juventæ Fons* measures $2\frac{1}{2}^{c}$ on Thomson's drawing, 3° on those of Phillips, and 4° on the Meudon delineations; an obvious result of the less nugatory effect of diffraction in the giant objective.

CANDOR is well represented brightest to S.E. by Phillips, on December 3 and 5, and whitish all along by the Director, on October 28, 31, December 4 and 6. It was less marked, at Meudon, on January 13.

LUNÆ LACUS figures as "a misty patch" on McEwen's sketch of December 4, and was well seen by him on December 7. Phillips, on October 28, describes it as "a diffused smudge, "elongated . . . . . towards *Margaritifer Sinus*." On December 11, Thomson also found a "faint smudge" here. In the $32\frac{3}{4}$-in., it always appeared elongated E. to W., large and diffused; and, on October 28 and 31, it showed a distinct *brown* tinge. Thus the nature of *Lunæ Lacus*, like that of *Campi Phlegræi* and *Xanthe*, differs from that of the other dusky markings.

OXIA PALUS was seen detached from *Margaritifer Sinus* by the Director, on October 31, November 3, and December 11.

NILIACUS LACUS underwent considerable changes in 1911–1912, and was never a very strong marking. McEwen saw it often brown. According to the joint data of Backhouse, McEwen, O'Hara, Phillips, Thomson, and of the Director, this "lake" was invisible through yellow cloud on August 23, September 23, 25, and 29, and on October 2; it looked faintish on October 28, 31, and November 3 (Fig. 27); was blotted out by white cloud on November 6 (Fig. 21), 7, and 9; appeared faint on December 3; darkish on December 4; was invisible on December 5; appeared again darkish on December 6;

looked faintish on December 11; darkish on December 12; was once more invaded by white cloud on December 14 and 15; looked faint on January 7 and 13; was again blotted out by white material on January 14; flashed forth "surprisingly "dark" on January 19; and was finally veiled by whitish cloud on February 20. These are unquestionable and remarkable changes!

ACHILLIS PONS was very vaguely glimpsed by the Director on October 31.

MARE ACIDALIUM suffered still more from the veils of the Martian atmosphere in 1911–1912. The drawings of the observers of *Lacus Niliacus* establish that it was rendered

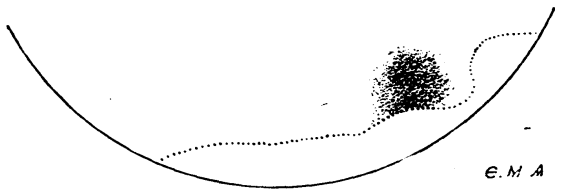

FIG. 27.—White cloud over *Mare Acidalium*. 1911, November 3. $\omega = 357°$. (The Director, 32¾-in.)

invisible by yellow material on August 23, September 23, 25, 29, October 1 and 2; that it was faintish on October 28 and 31; that it was almost completely masked by white cloud on November 3 (Fig. 27), 6, 7, 9, December 3, 4, 5, 6, 11, 12, 14, and 15; that it was faintish on January 7 and 13; that it was veiled by white material on January 14; that it looked dark on January 19; and that it was once more covered by white cloud on February 20. All these variations of appearance are real.

TEMPE was very bright to the Director on November 3.

MINOR DETAIL.

BÆTIS.—Phillips: December 3, 5, width 2°, dark.—Thomson: December 11, width 1°, dark.—The Director: October 28, 31, width 1½°, darkish edge of shade to N.E.; December 4, 6, width 1°, do.; January 13, edge of shade to N.E.

GANGES.—McEwen: September 24, December 7, width 4°, faint, "diffused orange streak."—Phillips: October 28, conspicuous edge of shaded *Xanthe;* October 29, width 6°, faintish; December 3, 5, width 10½°, faintish.—Thomson: December 11, width 3°, edge of shaded *Xanthe.*—The Director: September 18, width 5°, faint edge of shaded *Xanthe;* October 28, width 3°, do.; a second streak glimpsed 15° to E.; October 31, December 4, 6, January 13, mere edge of shaded *Xanthe.*

HYDRAOTES.—Phillips: October 28, to N.W. only, mean width 5°, faint.—The Director: October 31, to N.W. only, wavy, 3° wide.

INDUS.—McEwen: November 6, straight, width 4°, dark, "Saturn red"; January 19, to S. only, straight, 4° wide.—Phillips: November 6 and 9, convex to E., 2½° wide, very faint.—Thomson: December 12, convex to E., 3° wide to S.E., 1° to N.W., faint to N.—The Director: September 25, in 8½-in., convex to E., 4° wide, darkish; October 31, in 32¾-in., convex to E., 5° wide, faint; November 3, do., knotted; December 6 and 11, do., 6½° wide, by no means easy.

JAMUNA.—O'Hara : October 2, width 5°, faint.—Phillips : October 28, edge of shaded *Xanthe.*—Thomson : December 11, width 3°, faintish, "traced."—The Director : October 31, December 6, January 13, vague edge of shaded *Xanthe.*

NILOKERAS.—Phillips : October 28, edge of shaded *Xanthe;* December 3, 5, width 10°, faint and diffused.—The Director : October 31, December 6, and January 13, width 8°, smudgy edge of shaded *Xanthe.*

OXUS.—Thomson : December 12, to S. only, 2° wide.—The Director : October 31, to S. only, smudgy, mean width 5°, faint.

SECTION III.

Solis Lacus.

$\Omega = 70°$ to $120°$; $\Phi = -60°$ to $+60°$.

BOSPORUS GEMMATUS presented its normal appearance in 1911-1912, and was not a conspicuous mark. McEwen saw it once brown and "Delft blue,"* but "raw umber" on other occasions. The "strait," according to Backhouse, O'Hara, Phillips, Thomson, and the Director, appeared darkish on August 23 ; faint on September 18 and October 2 ; darkish on October 28 ; faintish on October 31, November 28, and December 3 ; darkish from December 4 to 6 ; faintish on December 7 ; darkish on December 11 and 12 ; faintish on January 7, 13, and 14 ; and darkish on February 20.

PHRIXI REGIO, less apparent than in 1909, was caught by Phillips on December 3 (Plate I., Fig. 2). In the large equatorial, it adjoined *Thaumasia*, and looked strongly shaded on October 28. It was more confuse on December 4. On October 31, it rose whitish on the limb.

DELPHINI PORTUS appeared dim, at Meudon, on December 4 (Plate I., Fig. 3).

CANCRI PORTUS, although smudgy, was a somewhat stronger marking, on the same date (Plate I., Fig. 3).

BATHYS PORTUS was still more prominent, on the same evening (Plate I., Fig. 3).

AONIUS SINUS is drawn by McEwen with its Schiaparellian outline ; but Backhouse (Fig. 28), Phillips, and the Director depicted it in the form it had at Meudon in 1909. McEwen saw brown and "Delft blue" tints here. From the joint data of these observers, and of those of O'Hara, we conclude that this "bay" seemed faint on August 11 ; darkish from August 15 to 17 ; faintish on September 18 and 20 ; darkish perhaps on September 21 ; faintish on October 17, 20, and 28 ; darkish on November 28 ; faint on December 3 ; darkish on December 4 ; faintish on December 5 ; faint on December 7 and January 7 ; and faintish again on January 14.

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* *See* p. 116.

At Meudon, *Aonius Sinus* was whitish, when setting, on October 17, and also whitish, after sunrise, on October 28. Hence the *maria* also may brighten sometimes near the periphery.

CHRYSOKERAS was observed shaded, but confusedly, with the $32\frac{3}{4}$-in., on December 4 (Plate I., Fig. 3).

This streak looked brightish at sunset, near the terminator, on October 17.

THAUMASIA, roughly oval in the ordinary appliances of Backhouse, McEwen, O'Hara, Phillips, Thomson, and in the

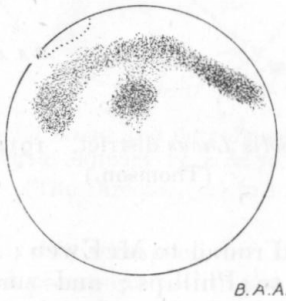

FIG. 28.—*Solis Lacus* and adjoining region. 1911, December 4, $\omega = 89°$. (Backhouse.)

$8\frac{1}{2}$-in. of the Director, had the complex 1909 form in the great objective. But the increased distance of the planet, and the moderate definition prevailing, showed it less detailed in 1911. The shading in its S. part, from *Nectar* to *Oeroe*, was seen by Backhouse on December 4 and 5, by Phillips on October 28, 29, December ·3 (Plate I., Fig. 2) and 5, and by the Director on September 18, October 20, 28, 31, December 4, 6, and January 13. *Heræum Promontorium* was still fairly marked to S., at the base of *Chrysokeras*.

On December 3 (Plate I., Fig. 2) and 5, Phillips drew a whitish spot in the N.W. part of *Thaumasia*, in the position of a similar marking observed at Meudon, at the previous apparition.* Is this a permanent feature here ?

The S. part of *Thaumasia* rose brightish on October 31, in the $32\frac{3}{4}$-in.

At Meudon, two dull white spots were noticed to protrude beyond the terminator, in E. *Thaumasia*, on October 20, as already described on p. 121.

AUREA CHERSONESUS comes out normal in the drawings of Backhouse, McEwen, O'Hara, Phillips (Plate I., Fig. 2), Thomson (Fig. 29), and the Director.

AMBROSIÆ LACUS was vaguely glimpsed in the Henry glass on October 28.

* *Mars Report* for 1909, p. 60, and Plate V.

EOSPHORI LACUS was also glimpsed with the large equatorial on December 4 (Plate I., Fig. 3).

SOLIS LACUS, so conspicuous in 1907, and so faint in 1909,* was again dark in 1911–1912. It appeared oval to Backhouse

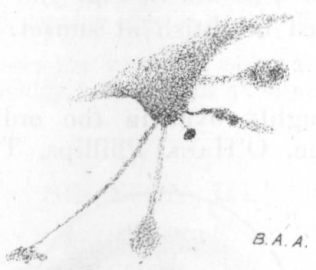

FIG. 29.—The *Solis Lacus* district. 1911, December 11. (Thomson.)

(Fig. 28); smaller and round to McEwen; larger, and elongated E.N.E. to W.S.W., to Phillips; and smaller, with the same trend, to Thomson (Fig. 29). In the $32\frac{3}{4}$-in., it was also elongated and very extended from E.N.E. to W.S.W., looked pear-shaped, large, and uniformly dark (Plate I., Fig. 3). Phillips found it "certainly complex," glimpsing "two dark "spots in it" (Plate I., Fig. 2), while Thomson also speaks of "condensations in this marking" (Fig. 29). McEwen saw a "sepia tint" here also. The intensity of this great "lake" underwent some changes in 1911–1912, for, according to Backhouse, McEwen, O'Hara, Phillips, Thomson, and the Director, the marking was faintish on August 16 and 17; darkish on September 18; invisible on October 2; darkish, but inferior to *Mare Sirenum*, on October 20; dark on October 28, 31, November 28, December 3, 4, 5, and 6; faintish on December 7; darkish on December 12; invisible (?) on January 3 and 7; dark on January 13; and faint (?) on January 14.

DÆDALIA showed nothing unusual in 1911.

TITHONIUS LACUS had its ordinary form to Backhouse, McEwen, O'Hara (Fig. 25), Phillips (Plate I., Fig. 2), Thomson (Fig. 29), and the Director (Plate I., Fig. 3 and Fig. 30). McEwen speaks of the "brown" tinge of this object. From the drawings of these amateurs we glean that *Tithonius Lacus* was invisible on August 16 and 17; that it was faintish on September 18, October 2 and 20; darkish on October 28 and 31; almost invisible on November 28; dark on December 3, 4, 5, and 6; darkish on December 7 and 12; invisible on January 7; certainly very faint on January 13; and darkish on January 14.

* The pallor of this marking at the previous apparition may be accounted for by the interposition of yellow cloud over its central regions.

As in 1909, *Tithonius Lacus* was compounded of several "lakes":—

FIG. 30.—*Solis Lacus* and neighbouring country.
1912, January 13, $\omega = 70°$.
(The Director, $32\frac{3}{4}$-in.)

CETI LACUS, admirably glimpsed by Thomson, with $12\frac{1}{4}$-in., on December 12, was conspicuous in the great instrument on October 28, looked very dark on December 4 (Plate I., Fig. 3), and black on December 6.

MELAS LACUS, well drawn intensely dark by Phillips on December 3 (Plate I., Fig. 2) and 5, and by Thomson on December 12, was also prominent and oval in the $32\frac{3}{4}$-in. on October 28, December 4 (Plate I., Fig. 3), and 6. It was black on these last two dates, and by far the darkest mark then visible on the planet.

HEBES LACUS, confused on October 28, was somewhat better defined, at Meudon, on December 4 and 6.

IUS LACUS presented the same phenomena as the preceding "lake," on the same dates, to the Director.

NOCTIS LACUS, fairly dark on October 28, was more detailed, at Meudon, on December 4.

ECHUS LACUS, very vague on October 28, looked easier, in the $32\frac{3}{4}$-in., on December 4.

All these components of *Tithonius Lacus* were seen in 1911 under much less favourable conditions than in 1909.

CORVI LACUS was glimpsed only once, on December 4, at Meudon, during this apparition.

PHŒNICIS LACUS, much less conspicuous than in 1909, was caught by McEwen on September 21, December 7, and January 7. Phillips found it at times "very dark." But in the large instrument it was never a black object in 1911. From the joint data of McEwen, Phillips, and the Director, it follows that this "lake," when visible, had a variable intensity; faintish on September 18, October 20 and 28, in the $32\frac{3}{4}$-in.,

it was dark to Phillips on October 29 and December 3, and, in the $32\frac{3}{4}$-in., on December 4; darkish again to Phillips on December 5; and it looked faintish to McEwen on December 7.

OTI LACUS seemed confuse, at Meudon, on December 4 (Plate I., Fig. 3).

ASCRÆUS LACUS was observed large and diffuse on September 18, with the $32\frac{1}{4}$-in. Yellow cloud must have veiled it to Phillips on October 28, 29, December 3 and 5, and to the Director on October 20 and December 4.

OPHIR, generally brownish to McEwen, rose white, in the big glass, on September 3 and October 31.

THARSIS, which bulged on the terminator on January 13 (Fig. 17),* brightened a bit before sunset, to the Director, on October 17.

MINOR DETAIL.

AGATHODÆMON.—Backhouse: December 5, width 6°, dark.—McEwen: November 28, width 5°, faintish; December 7, width 4°, do.; January 14, width 3°, do.—O'Hara: October 2, width 7°, faint.—Phillips: October 28, 29, width 4°, faintish; December 3, 5, under good definition, convex to S.W., 3° wide, very dark to E.—Thomson: December 11, 12, convex to S.W., mean width $2\frac{1}{2}$°, dark to E.—The Director: September 18, convex to S.W., $3\frac{1}{2}$° wide, darkish to E.; October 28, 31, do., 3° wide, very dark to E.; December 4, do., $3\frac{1}{2}$° wide, black to E. (Plate I., Fig. 3); December 6, do.; January 13, width 4°, dark, diffused (Fig. 30).

AMBROSIA.—The Director: October 28, a diffused "lake," here, as in 1909,† is instrumental in giving a linear impression in ordinary appliances.

CERAUNIUS.—McEwen: September 21, November 23, 28, and January 3, a brownish, amorphous smudge.—O'Hara: October 2, width, 15°, darkish near limb.—The Director: December 4, to N. only, 15° wide, amorphous.

CHRYSORRHOAS.—McEwen: December 7, width 4°, faint.—Phillips: October 28, 29, December 3, width $6\frac{1}{2}$°, very faint.—The Director: October 28, convex to N.W., 6° wide to S., 3° to E., very faint.

DARDANUS.—Phillips: October 29, trending to S.W., $4\frac{1}{2}$° wide, exceedingly faint.

EOSPHOROS.—McEwen: November 28, December 7, 4° wide.—The Director: December 4, only an isolated "lake" here, as in 1909,‡ shaping, in small telescopes, the monstrous apparition of a straight line.

FORTUNA.—McEwen: November 28, width 6°, very faint.—O'Hara: October 2, width 15° near the limb.—The Director: September 18, width 6°, exceedingly faint.

IRIS.—The Director: September 18, amorphous, exceedingly faint.

NECTAR.—Backhouse: December 5, width 4°, darkish.—McEwen: November 28, December 7, width $4\frac{1}{2}$°, darkish.—Phillips: October 28, 29, width 3°, faint, edge of shade to S.; December 3 and 5, width $2\frac{1}{2}$°, edge of shade to S.—Thomson: December 11, width 3° dark.—The Director: September 18, 28, October 31, December 4 and 6, width 4°, darkish and irregularly wavy, edge of shade to S.; January 13, mean width 5°, broadens to W., edge of shaded area to S.

NIA.—McEwen: December 7, width 3°, dark.—The Director: December 4, width 2°, faint.

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* *See* p. 121.

† *Mars Report* for 1909, p. 42, Fig. 36.

‡ *Ibid.*, p. 42, Fig. 38.

Nilus.—Phillips : December 3, 5, width 10°, very faint and diffused.

Oeroe.—Phillips : October 29, December 3 and 5, width 4°, edge of shade to S.E.—The Director : September 18, October 20, December 4 and 6, width 5°, not difficult, edge of shade to S.E.

Phasis.—McEwen : November 28, December 7, January 7 and 14, mean width 4°, faintish generally.

Tithonius.—Phillips : October 29, width 4°, faint ; December 3, 5, width 8½°, very faint.—The Director : September 18, width 4°, faint ; October 20, 28, December 4, width 6½°, faint. This band was fainter in 1911 than in 1909.

SECTION IV.

Mare Sirenum.

$\Omega = 120°$ to $180°$; $\Phi = -60°$ to $+60°$.

Palinuri Fretum, generally much less prominent than at the previous apparition, looked slightly duskier than *Aonius Sinus*, at Meudon, on October 20. On December 3, Phillips saw it covered, near the terminator, by a whitish mass, extending over *Thyle I.* and *Phaethontis*.

Icaria, mostly yellow to McEwen, appeared strongly shaded, as far as *Hyscus*, to Backhouse (Fig. 28), O'Hara (Fig. 31), Phillips (Fig. 33), and to the Director (Plate I., Fig. 3). The Schiaparellian outline to S.E. of this "land" is closely followed by McEwen ; but Phillips, and, especially, the Director, barely indicate it ; while Backhouse and O'Hara ignore it completely.

Icaria was bright, at sunset, on March 15, to McEwen.

A sparkling projection on *Icaria* jutted out of the terminator, at Meudon, on October 14, as already stated on p. 121.

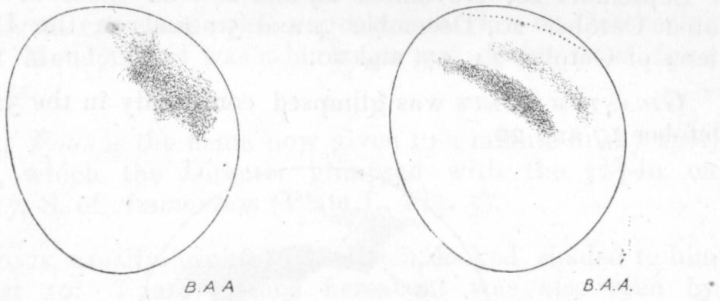

FIG. 31.—August 16, $\omega = 119°$. FIG. 32.—August 11, $\omega = 149°$.
The *Mare Sirenum* region in 1911, after O'Hara.

Phaethontis is drawn shaded by McEwen, except on November 28, when the conditions were good. Backhouse and Phillips show no duskiness here, while O'Hara (Fig. 31) and, especially, the Director, saw the whole of this district as a half-tone.

Phaethontis rose bright to McEwen on September 16 and 24, to Phillips on December 5, and to the Director on December 4 and 6.

MARE SIRENUM, less dark than in 1909, presented but few features of particular interest in 1911–1912. McEwen and Phillips draw the *p.* beak fairly tapering, while Backhouse (Plate I., Fig. 4), O'Hara, and the Director concur in showing it more rounded. In the $32\frac{3}{4}$-in., during gleams of comparative calm in flickering air, it revealed, though more confusedly, the 1909 outline and shading. Thus the serrated "coast" was blurred near *Sirenum Promontorium*, which was still fairly easy. The darkest part was at the bend; and *Ios Insula* of 1909 was repeatedly observed as a lightening of the dusky area (Plate I., Fig. 5). The colour of *Mare Sirenum*, which is generally described brown, and. on one occasion, both "sepia" and "Delft blue,"* by McEwen, appeared distinctly greenish indigo grey, in the large telescope of Meudon. As to the intensity of this "sea," it underwent, according to the drawings of Backhouse, McEwen, O'Hara, Phillips, and the Director, the following variations: darkish on August 8, 11, and 15, *Mare Sirenum* looked faintish on August 16; it was then darkish on September 6 and 8; faintish, save to E., on September 18; faintish on September 20; darkish on September 21; faintish, to W., on October 10 and 11; dark on October 15, 17, and 20; darkish on October 28; faintish on November 19; darkish on November 21 and 22; dark on November 23; darkish on November 24, 25, 28, December 3, 4, 5, 28; faintish on January 3 and 7; darkish on February 2; and faint on February 4 and March 15.

SIRENUM SINUS comes out squarish on some drawings of Backhouse and O'Hara, probably on account of the strong shading of *Icaria*. On October 20, it was very large and blunted, at Meudon.

GORGONUM SINUS is represented on McEwen's delineations of September 20, November 24 and 28; on those of Phillips, dated October 20, December 4 and 5; and on the Director's views of October 14, 17, and 20.

GIGANTUM SINUS was glimpsed confusedly in the $32\frac{3}{4}$-in. on October 17 and 20.

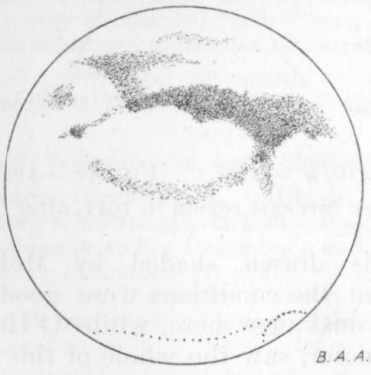

FIG. 33.—*Mare Sirenum* and neighbouring district.
1911, December 4, $\omega = 154°$. (Phillips.)

* *See* pp. 115–116.

TITANUM SINUS is easily recognisable on the sketches of Backhouse, McEwen, O'Hara, Phillips, and of the Director. McEwen found this bay "the darkest part of *Mare Sirenum*," on November 22. Phillips writes that, on November 29 and on December 3, he "thought the tip of *Sinus Titanum* peculiar," and that there was "either a hazy spot or 'lake' there, or else a "light bank of cloud, or fog, lying across the *Sinus*." (Fig. 33.)

ATLANTIS, often noted brownish by McEwen, was quite distinct to Phillips, on October 20. This is one of those Schiaparellian markings which do not stand good seeing conditions in a really powerful instrument.

MEMNONIA appeared whitish, at Meudon, near *Titanum Sinus*, on October 17. Its colour was a bright yellow, in the $32\frac{3}{4}$-in., three days later.

According to the joint data of McEwen and Thomson, *Memnonia* was "very white," when setting, on September 14; "very bright," rising, on September 21 and 22; and bright again, setting, on November 28 and February 3.

NODUS GORDII was "faintly but distinctly seen" by McEwen on September 16. Nothing definite and no interfused streaks could be deciphered here, with the large instrument.

MEDUSÆ FONS was glimpsed at Meudon as a diminutive object, $2\frac{1}{2}^{\circ}$ across, on October 17 and 20, and seemed engaged in the complex half-tones N. of *Titanum Sinus*.

AQUÆ APOLLINARES were also glimpsed, in the great objective, on October 14, 17, and 20, as a dusky knot, 4° across, and lying on the shadings to the N.W. of *Mare Sirenum*.

AMMONIUM came somewhat vaguely into view on October 14 and 20, at Meudon, and was a bit larger and darker than *Aquæ Apollinares*.

PERSEI FONS is the name now given to a minute dusky spot, 2° across, which the Director glimpsed with the $32\frac{3}{4}$-in. on October 17, S. of *Ammonium* (Plate I., Fig. 5).

AMAZONIS, usually bright to McEwen, looked shaded to him on August 10. The half-tone hereabout was also seen by Backhouse, on December 1 and 30; by O'Hara, on September 18 and 21; by Phillips, on October 20; and by the Director, on October 14, 17, and 20. It seemed limited, to S., by the invisible *Eumenides*, and to S.W., by the jagged *Tartarus*.

Amazonis rose whitish to McEwen on September 22.

A bright white spot was seen, on the limb, at Meudon, on October 28, in $\Omega = 135^{\circ}$, $\Phi = +25^{\circ}$, not far from the *Nix Olympica* observed by Schiaparelli in 1877 and 1879.

ARCADIA appeared shaded to the Director on October 17 and 20; to Phillips on the last-named date; and to Backhouse on November 28.

*TITANIA** had the form of a dim, dusky triangle, at Meudon on October 28.

MINOR DETAIL.

ARAXES.—Phillips: October 29, width 2°, very faint; December 3, 4, 5, width 3°, very faint.—The Director: September 18, width 4°, very faint; October 17, 20, mean width 7°, wavy, faint; December 4, mean width 7°, diffused and faint.

BRONTES.—McEwen: November 19, 21, 22, 24, chiefly to S., width 3°, faint.

EUMENIDES.—McEwen: November 22, 24, 28, width 3°, faintish.—O'Hara: September 18, 21, S. edge of shaded *Amazonis*.—Phillips: October 29, to S.E. only, 4° wide, very faint; December 4 and 5, do., 4½° wide, very faint, edge of shaded *Amazonis*.—The Director: October 14, 17, 20, ragged S.W. edge of shaded *Amazonis*.

GIGAS.—Phillips: October 29. December 3, "a very soft, hazy streak," to E. only; December 4, seen to S.W., 10° wide, diffused, faint; December 5, to E. only, 10° wide, exceedingly faint.

GORGON.—McEwen: September 21, November 24, 2½° wide, tends to widen to N.—The Director: October 20, as in 1909, but less distinct, 3° wide to S., 20° to N., winding, convex to N.W., very faint.

HERCULIS COLUMNÆ.—McEwen: November 28, width 3°, "very conspicuous."—The Director: as in 1909, nothing here.

HYSCUS.—Backhouse: November 28, December 4, edge of *Icaria* half-tone.—O'Hara: August 16, September 18, 21, edge of *Icaria* shading.—Phillips: October 29, December 3, 4, 5, edge of *Icaria* shading.—The Director: September 18, October 17, 20, mere N.E. edge of *Icaria* half-tone.

PYRIPHLEGETHON.—McEwen: November 28, width 3°, faintish.—Phillips: December 5, to S. only, 2° wide, most faint.—The Director: October 20, glimpsed between Ω = 128° and 146°, width 8°, amorphous, faint.

SIRENIUS.—McEwen: September 21, width 3° to S., widens to N.; November 28, width 4°, straight, faint.—The Director: October 17, 20, width 4° to S., wavy, broadens to N., very faint indeed.

TITAN.—McEwen: August 8, width 10°, diffuse; September 21, October 14, November 19, 21, 22, 24, mean width 4°, faintish.—Phillips: December 4, to S. only, 10° wide, faint.—The Director: October 14, 17, 20, runs out of the N.W. front of *Mare Sirenum*, 4° wide to S., wavy, and expands to N. into a vast shading, limited, to S.W., by the jagged *Tartarus*.

SECTION V.

Mare Cimmerium, Elysium, and Trivium Charontis.

Ω = 180° to 250°; Φ = − 60° to + 60°.

MARE CHRONIUM was frequently seen by McEwen in 1911–1912, but was never a prominent marking. The joint data of this observer with those of Phillips, Thomson, and the Director, show the *mare* to have been darkish on September 16 and 21; dark at the ends, faint in the middle, on October 11, 14, and 17; very faint on October 20; darkish on November 19; faintish on November 22; dark to W., on November 23; faint on

* *See Mars Reports* for 1900-1901, 1903, and 1905.

November 24 ; darkish on November 25 ; faintish on November 27, December 22, 24, and 26 ; unnoticed on January 28 ; darkish on February 3 and 4 ; faintish on February 10 ; and faintish on March 15.

TIPHYS FRETUM looked very inconspicuous. According to Phillips, Thomson, and the Director, it seemed very faint on October 11 ; darker on October 14 ; exceedingly faint on November 13 and 14 ; faintish on November 19 and 23 ; dusky on December 23 ; faintish on December 26 ; and invisible on January 28.

ELECTRIS, brightish ruddy to McEwen and Phillips, appeared dusky to Backhouse on December 25 and January 3. It was always shaded to the Director, in both telescopes, and particularly so on October 10, 11, 14, 17, and 20.

On November 25, McEwen saw the S. edge of *Electris* " very " white."

ERIDANIA, shaded in 1907, and bright rose in 1909, was again greyish in 1911-1912. A curious return to a former state ! The half-tone is not shown by McEwen ; Phillips draws it vaguely ; but it was easy to Backhouse, to Thomson, and to the Director. The colour of *Eridania* was yellow in the large instrument, on October 11, 14, and 20 ; and this land must have been usually covered by orange cloud in 1911.

From the joint results of McEwen, Phillips, and the Director, we conclude that *Eridania* looked bright, when risen, on September 21 ; that its W. part was whitish, on the limb, on October 17 ; that an irregular bright spot lay over its S.W. end, near the limb, on October 20 (Fig. 34) ; that its central regions were whitish on November 19 ; and that it again rose bright on November 24.

FIG. 34.—*Eridania*, appearing partly white, after sunrise. 1911, October 20, $\omega = 140^{\circ}$. (Meudon, $32\frac{3}{4}$-in.)

MARE CIMMERIUM, cigar-shaped, as usual, was moderately dark in 1911, but more intense than *Mare Tyrrhenum*. Its *f.* end, indistinguishable from *Hesperia*, to Backhouse and O'Hara, appeared blunted to McEwen, and more tapering in the superior appliances of Phillips (Plate I., Fig. 6), Thomson (Fig. 35), and of the Director. In the $32\frac{3}{4}$-in., the outline of *Mare Cimmerium* was very irregular, as in 1909, *Læstrygonum Sinus* indenting the " coast " deeply, while *Tritonis Sinus* again ended almost in a sharp " estuary " to N.W. The two " bays " near the *Cyclops* were less prominent. The colour of this *mare*, brown,

as a rule, to McEwen, and both brown and "Delft blue," on December 28, at Glasgow, looked grey in the large equatorial. As at the previous apparition, the shading was by no means uniform here, the darkness along the "coast" from *Læstrygonum Sinus* to *Cyclopum Sinus* being particularly noticeable. McEwen refers to the neat visibility and "dull grey colour" of *Cimmeria Insula*. The phenomena presented by Martian cloud over *Mare Cimmerium* were very remarkable in 1911. The drawings of Backhouse, McEwen, O'Hara, Phillips, Thomson, and of the

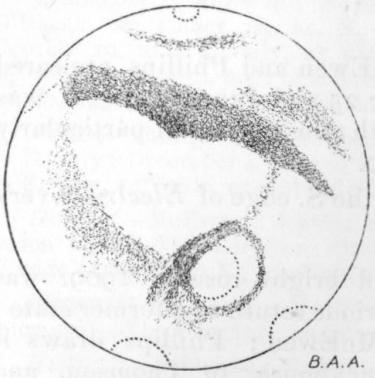

FIG. 35.—November 27, $\omega = 200° \pm$. (Thomson.)

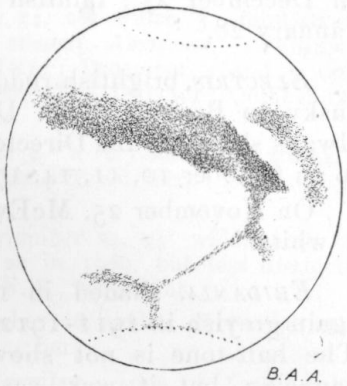

FIG. 36.—October 14, $\omega = 213°$. (McEwen.)

The *Mare Cimmerium* region in 1911.

Director, show that the "sea" was faintish on August 8 and 11; darkish on September 6 and 8; faintish, save to E., on September 18; faintish on September 20; darkish on September 21; faintish to W., on October 10; darkish on October 12; darkish on October 14, save to W., where the "beak" was blotted out by intense white cloud; darkish on October 15 and 17; rather faintish, veiled S. of *Læstrygonum Sinus* on October 20; faintish on November 13 and 14; darkish on November 19 and 21; faintish on November 22; dark on November 23; darkish on November 24, 25, 28, December 3, 4, 5, and 28; faint on January 3, 7, and 14; darkish on February 2, 3, 4; and very faint on February 20 and March 15. McEwen writes: "A large and very light ochre-coloured patch "appeared to cut right into *Mare Cimmerium* immediately to "the E. [W.] of where the *Cyclops* joined it," on December 22. The distortion of *Mare Cimmerium* by white cloud on October 14, admirably shown by McEwen (Fig. 36), was one of the most interesting features of the apparition. At 23^h of that day, $\omega = 195°$, the W. end of the *mare* was quite concealed by the bright area, which enhanced, by contrast, the adjoining parts of the cigar-shaped "sea." As already stated,* the cloud mass extended a long way to W., forming, moreover, an isolated patch to the N. of the "estuary" of the *Cerberus*.

SYMPLEGADES INSULÆ were successfully observed by Phillips on November 22 (Plate I., Fig. 6), as an oval "island" to the

* *See* p. 124.

S.E. of *Læstrygonum Sinus*. At Meudon, on October 14, they appeared, as in 1909, compounded of three ragged half-tones; but only dim views of them were had three days later.

SCAMANDRI SINUS looked like a dark knot to Phillips on October 20; but, in the $32\frac{3}{4}$-in., it was less conspicuous than in 1909.

LÆSTRYGONUM SINUS, easy to McEwen and to Phillips, was examined, on October 14, during a gleam of grand definition, when the Henry objective unravelled, for some 2 seconds, the fact that the E. "coast" is much more blunted here than the W. one. (Fig. 37.)

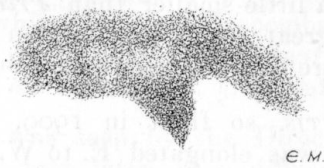

FIG. 37.—*Læstrygonum Sinus*, on 1911, October 14. (The Director.)

CYCLOPUM SINUS, often shown by McEwen, was glimpsed once by Phillips, on November 23. Generally, it was seen, at Ashtead, together with *Cerberi Sinus*, as a single hump. At Meudon, *Cyclopum Sinus* could be satisfactorily scrutinized on October 11, 14, November 13, 14, and on December 23.

CERBERI SINUS, although drawn by Phillips on November 23, appeared to him usually confuse with *Cyclopum Sinus*. It was observed, in the large instrument, on the same dates as the foregoing "inlet."

TRITONIS SINUS, rounded to McEwen, and more pointed to Thomson, looked tapering, with a N.W. trend, in the appliances of Phillips, as well as at Meudon.

HESPERIA is shaded on the drawings of Backhouse, McEwen, O'Hara, Phillips, Thomson, and of the Director. On October 14, the great white cloud formation, as seen from France, blotted out completely four-fifths of the "peninsula." These regions were further veiled by yellow cloud on November 13 and 14.

Hesperia whitened to McEwen near sunset on September 4.

HYRIA LACUS was always seen confusedly, in the $32\frac{3}{4}$-in. on October 11, November 13, 14, and on December 23.

ZEPHYRIA, brightish, at Meudon, near *Titanum Sinus*, was faintly white when rising, on October 20, and set "very bright," to McEwen, on February 3.

ÆOLIS presented a large whitish spot in Thomson's telescope, on December 26 (Fig. 53).

Æolis rose bright to McEwen on September 10, and set "very bright" to him on October 10.

ÆTHIOPIS was described very "white" by McEwen on September 10. The large telescope showed, on November 14, that the whole S.W. part of this district was yellow and brightish, as represented on Plate III.

A small white spot, 4° across, was held steadily, at Meudon, on November 13, in $\Omega = 250°$, $\Phi = +3°$.*

CERBERI LACUS is the name now given to a diminutive object, revealed by the $32\frac{3}{4}$-in. on November 14, in $\Omega = 233°$, $\Phi = +2°$. A short view only of it was had at the time, and it looked blackish.†

PAMBOTIS LACUS is recognisable on McEwen's drawings of November 21 and December 28, and on Phillips's sketch of October 20. It was a little smaller than *Trivium Charontis* on October 20, in the great telescope; but on November 13, 14, and December 23, there was nothing remarkable about it.

TRIVIUM CHARONTIS, so faint in 1909, looked duskier in 1911.‡ The "lake" was elongated E. to W. and had diffused borders under the indifferent definition prevailing. McEwen speaks of its raw umber tint. According to the combined results of Backhouse, McEwen, O'Hara, Phillips, Thomson, and the Director, the *Trivium* was faintish on September 6 and 8; invisible on September 9; quite faintish on October 10, 11, 14, 15, and 17; darkish on October 20; dark on November 13; darkish on November 14; faintish on November 19, 21 to 23; invisible on November 24; faint on November 25; faintish on November 28; invisible on December 21; darkish on December 23, 25, 26, 28, and 30; faintish on January 3 and 28; faint on February 2; exceedingly faint on February 3 and 4; and again invisible on March 15.

ELYSIUM, owing to reduced diffraction, looks naturally smaller, like all bright spots, in a big aperture than in a modest one. It was pentagonal, with blunted angles, in 1911–1912; and, in the $32\frac{3}{4}$-in., it measured 28° from N. to S. and 24° from E. to W. Generally brighter than the surrounding districts, it seemed whitest near its E. end to Phillips and Thomson (Fig. 35); possibly a contrast effect with the darkness of *Trivium Charontis*. The joint data of McEwen, O'Hara, Phillips, Thomson, Price, and the Director, establish that

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* Gledhill in 1871, and Burton in 1882, drew something analogous on *Æthiopis*. Eddie saw something similar in 1907. (*Mars Report* for 1907, p. 90.)

† A "lake" was detected here by the Director on Dr. Lowell's beautiful photographs of 1907. (*Monthly Notices*, R.A.S., Vol. LXIX., Plate IV., p. 112.)

‡ Backhouse writes on December 25: "The lake *n.* of the equator is "very distinct. I never saw this lake distinctly before." And "in 1905 "it was very faint. In 1873 and 1869 it was very faint, not like a lake "but a gulf [probably owing to the visibility of *Cerberus* and *Cyclops*]. "In 1871, April 8 and 10, it was more of a lake, though very faint and "indefinite. In 1867, there was only a very faint duskiness extending "from *Phlegra*."

Elysium looked dull on September 6 and 8; that it was invisible, when setting, on September 9; that it was again invisible, at sunrise, on September 20; dull, setting, on October 10; brightish yellow, near C.M., on October 11; not very bright, risen, on October 14 and 15; white, at sunrise, on October 17; white, rising, but dull near C.M., on October 20; dull, setting, on November 10; whitish, setting, on November 13; confuse, near sunset, on November 14; brightish yellow, risen, and near C.M., on November 19; yellow, risen, on November 21 and 22; brightish, near C.M., on November 23; yellow, near centre, on November 24; not white, risen, on November 25; dull, near C.M., on November 28; invisible, setting, on December 15; invisible on December 21; brightish, near sunset, on December 23; yellow on December 25; dull, near limb, on December 26; not white, risen, on December 28; invisible on December 30; dull, near limb, on January 28; and almost invisible, near C.M., on February 2, 3, 4, and on March 15.

Hecates Lacus was seen by the Director on October 14, and by Phillips, six days later, as a diffused dusky spot, some 6° across.

Morpheos Lacus also had a diameter of 6°, in the $32\frac{3}{4}$-in., on October 14.

Phlegra presented a "terra-cotta tint" to McEwen on February 4, and was invariably shaded to Phillips and to the Director.

Propontis could be "faintly but distinctly seen" by McEwen on September 16. Phillips caught it, as a darkish, but diffused, condensation on October 20, November 22 (Plate I., Fig. 6) and 23. The Director saw this "lake" on October 14, 17, and 20, when it was noted faint. Phillips found *Propontis* encroaching upon the N. cap on November 22.

Cebrenia, shaded to Phillips and to the Director, rose whitish to the former on December 4, and to McEwen on November 19.

Ætheria, faintly shaded to Phillips, Thomson, and to the Director, was brightish, at sunrise, to Thomson, on November 28.

Minor Detail.

Adamas.—Phillips: November 10, to N.W. only, 7° wide, dark; November 19, 23, stretching to *Pambotis Lacus*, 4° wide, dark to N.W.; December 15, dark to N.W., invisible more to S.E.—Thomson: November 19, December 26, January 28, running to *Pambotis Lacus*, 3° wide, faint.

Æthiops.—Phillips: November 23, running into *Adamas*, convex to S.W., 4° wide, conspicuous to S.

Antæus.—McEwen: November 21, 25, December 28, running up to *Atlantis*, 4° wide, "Indian red tint."—Phillips: October 20, width 4°, faint, originating at *Læstrygonum Sinus*.—The Director: October 14, to

S.E. only, beginning on *Læstrygon*, and not attaining *Pambotis Lacus*, irregularly wavy, knotted, areolated, as in 1909, mean width 4°.

AVERNUS.—McEwen: November 21, mean width 3°, "dark."—O'Hara: September 20, width 4°, not reaching the *mare* to S.

CERBERUS I.—Backhouse: December 25, 30, width 8°, dark.—McEwen: October 14, width 3°, dark; November 6, width 6°, diffused; November 19, 21, width 4°, darkish; November 22, 24, 25, width 5½°, faintish; December 28, width 10°, faintish, "raw umber tint"; February 2, width 6°, faintish; February 3, 4, width 8½°, faintish.—O'Hara: September 6, 8, mean width 8°, faintish, broadest to N.E.—Phillips: October 20, triangular, width 8° to N.E., 3° only to S.W., dark; November 19, 22, 23, width 8° to N.E., 6° to S.W., very dark.—Thomson: November 19, width 3°, "brown," darkish; November 28, width 6° to N.E., 4° to S.W., dark and anomalously doublish; December 26, width 4°, "very dark"; January 28, mean width 4½°, "very dark"; March 11, "very plain."—The Director: October 10, in 8½-in., 5° wide, darkish; October 11, and after, in 32¾-in., 7° wide, knotted, darkish, better defined on *Elysium* than on *Æolis*; October 14, width 6°, knotted, darkish; October 17, near limb, intensified edge of bright *Elysium*, rising; November 14, December 23, mean width 5°, faintish perhaps, and diffused.

CERBERUS II.—McEwen: November 21 (Plate II., Fig. 1), December 28, width 3½°, faintish.—Thomson: December 26, seen; March 11, "suspected."

The existence of *Cerberi Lacus* may help to bring about the visibility of this stripe, whose objectivity is doubtful.

CHAOS.—McEwen: October 14, "raw umber shading"; November 19, width 6°, faint.—Phillips: November 19, 22, 23, convex to N., 5° wide, edge of shaded *Cebrenia*.—Thomson: November 28, convex to N., 4° wide, faint; January 28, width 4°, faint.—The Director: October 11, edge of shaded *Cebrenia*; October 14, November 14, width 6°, do.

CYCLOPS.—McEwen: October 14, width 9° to S., 4° to N., dark; November 19, 21, width 3°, darkish; November 22, width 3°, faintish; November 25, December 28, width 4°, darkish; February 2, 3, 4, width 5°, faintish.—O'Hara: September 6, 8, width 4°, faint, does not reach the *mare* to S.—Phillips: November 19, 22, 23, invisible.—Thomson: November 28, December 26, January 28, width 4° nearly, diffused; March 11, "suspected."—The Director: October 10, in 8½-in., 4° wide, faintish; October 11 and after, in 32¾-in., width 3°, faintish; October 14, width 4°, do.; November 13, to S. only, width 3°, faintish; November 14, width 4°, faint; December 23, invisible.

EREBUS.—Phillips: October 20, width 3°, diffuse, "easy."

EUNOSTOS.—McEwen: November 19, 28, February 4, mean width 7°, faintish.—Phillips: November 19, 22, 23, convex to S.W., width 4½°, exceedingly faint.—Thomson: November 28, convex to S.W., 4° wide, very faint; December 26, do. doubtfully seen; January 28, width 3°, faint.—the Director: October 11, edge of shaded *Æthiopis*; October 14, width 6°, do.; November 14, December 23, width 5°, faint, do.

HADES.—Phillips: November 22, width 4°, E. edge of shaded *Phlegra*, "soft but not difficult."

HYBLÆUS.—McEwen: November 19, width 4°, very faint.—Phillips: November 19, 22, 23, convex to N.W., 5° wide, edge of shaded *Ætheria*.—Thomson: November 19, 28, January 28, width 4°, convex to N.W., usually faintish.—The Director: October 11, 14, width 5°, edge of shaded *Phlegra*.

LÆSTRYGON.—McEwen: November 19, 21, and 22, December 28, width 3°, faint.—The Director: October 14, width 3°, sinuous though straight as a whole, exceedingly faint. Obviously obliterated by yellow cloud in 1911.

ORCUS.—McEwen: November 22, 24, 25, and 28, mean width 3°, faint.—Phillips: October 20, "a broad, soft shading, sharp to S., diffused to N.," where *Phlegra* is dusky.—The Director: October 14, edge of shade to N.

STYX.—McEwen: October 14, width 10°, faint, "raw umber"; November 19, 21, mean width 6°, very faint.—Phillips: October 20, width 6°, diffused, "glimpsed"; November 19, convex to E., width 7°,

conspicuously drawn; November 22, 23, edge of shaded *Phlegra*, "soft, but "not difficult streak."—Thomson: January 28, width 6°, darkish.—The Director: October 11, edge of shaded *Phlegra*; October 14, width 6°, do.

TARTARUS.—McEwen: August 11, width 8°, diffused; November 19, 21, and 25, width 3°, to S. chiefly; December 28, width 3°, darkish, "Indian "red tint."—Phillips: October 20, and November 22, convex to N.W., width 5°, faint, "soft and hazy."—Thomson: November 28, convex to N.W., width 3°, edge of shade to N.E.; a wonderful result for the aperture used. —The Director: October 14, 17, and 20, jagged edge of shade to N.E., exactly as in 1909.

XANTHUS.—Thomson: December 26, width 4½°, darkish, "very distinct." —The Director: December 23, mean width 8°, diffused and faint.

SECTION VI.

Mare Tyrrhenum and Syrtis Major.

$\Omega = 250°$ to $310°$; $\Phi = -60°$ to $+60°$.

PROMETHEI SINUS, veiled by yellow cloud in November,* flashed forth as a strong marking on December 23, at Meudon, when the whole of these regions revealed the true colour of their surface. It was "clearly outlined," on January 28, by McEwen, who, on February 3, described the "brown ochre" tinge of this "bay."

CHERSONESUS requires considerable aperture to be defined. Indistinguishable to most Members of the Section, it was seized by Thomson on December 26. During the pallor of November, it looked confuse; but on December 23, when the yellow material had cleared off, the 32¾-in. showed *Chersonesus* with its fiery red tint and with the outline it had in 1909.

The "peninsula" was bright, when risen, to the Director, on October 14, and to McEwen, on November 21.

AUSONIA, vague and almost limitless to Backhouse, McEwen, O'Hara, Phillips, Thomson, and Price, presented very diffused borders also in the great instrument, under invariably tremulous definition. Yet it had clearly the same form as in 1909, and *Circæum Promontorium* was barely indicated. The great yellow veil, 5,000 miles across, which practically concealed so many surface features S. of the equator in November, from longitude 220° to 60°, increased the difficulty of outlining this shaded "island"; and it was only at the dissipation of the S.E. part of the cloud area, on December 23,† that the intense red colour and S. "coasts" of *Ausonia* could be scrutinized to advantage with the 32¾-in. (Plate III.).

From the combined data of McEwen, O'Hara, Thomson, and the Director, we find that *Ausonia* appeared to S. as a bright area with *Hellas* on August 11, September 3 and 4; that a

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* *See* p. 124. † *See* p. 123.

small part of it, to S., rose white, on September 6 and 8 ; that the whole "land" was whitish after sunrise, on October 10 and 11 ; that it set bright, on December 22 ; that it rose white, on February 2 and 4 ; and that it was again bright, near sunset, on March 3.

At Meudon, on November 9, the large telescope revealed a small white spot, in central *Ausonia*, 3° in diameter.

Perræa was glimpsed in the $32\frac{3}{4}$-in. on November 9, as a confuse yellow stripe.

Hadriacum Mare, brownish to McEwen, underwent variations of intensity in 1911–1912. The drawings of Backhouse, McEwen, O'Hara, Phillips, Price, Thomson, and of the Director, establish that this *mare* seemed faintish on September 3, 4, 5, and 9 ; darkish on October 8 ; faint on October 10, November 6 and 7 ; very faintish on November 9 and 10 ; rather darkish on November 14 ; faintish on November 19 ; darkish to E. on December 15 ; faintish on December 21 and 22 ; dark to S.E., near ruddy *Ausonia*, on December 23 and 26 ; faintish on January 3 ; and darkish on January 28.

Hellas, semicircular, on the N. side, to McEwen and Price, appeared oval, elongated N. and S., to Thomson, and irregular, with a flattening to N.E., to Phillips. This was also the general outline it had at Meudon, with the addition, however, that the "bay" to N.E., *Portus Bucoleontis* of 1909, was still there, although dimly defined in quivering images. This most diminutive object, in the middle of the lobate form, did not elude the keen-sightedness of O'Hara (Plate II., Fig. 4). *Zea Lacus* was vaguely suspected by the Director on November 9. Phillips and Thomson found the S. part of *Hellas* to have been fainter than the N. one. From the joint drawings of Backhouse, McEwen, O'Hara, Phillips, Price, Thomson, and of the Director, we glean that this "island" was very whitish, when risen, and on C.M., on September 3 ; intensely whitish, rising, on September 4 ; dull, on C.M., on September 5 ; dull, near full limb, on September 6 ; dull white, rising, on September 9 ; invisible, setting, on September 29 ; dull, on C.M., on October 8 ; dull, risen, and on C.M., on October 10 ; faintly whitish, setting, on November 3 and 6 ; yellow, setting, on November 7 and 8 ; bright, near sunset, on November 9 ; yellow, on C.M., or near it, on November 9, 10, 13, and 14 ; yellow, near sunrise, on November 14 ; dull, risen, on November 19 and 22 ; dull yellow, setting, on December 11 and 12 ; invisible, in the $32\frac{3}{4}$-in., near sunset, on December 14 and 15 ; dull, on C.M., on December 15 ; dull, setting, on December 19 ; dull, risen, on December 21 ; dull, near C.M., on December 22 ; yellow, risen, on December 23 and 26 ; whitish, near C.M., on January 3 ; and dull, rising, though bright to N.E., on January 28 (Plate II., Fig. 2). We safely infer that *Hellas* was always more or less covered with yellow cloud, which concealed its red soil, and that it whitened occasionally near the periphery, in 1911–1912.

Thomson rightly calls attention to the presence of a "*bright* "spot in [N.W.] *Hellas*,"* on December 22, and to another "intensely brilliant" mark, to N.E., which looked "like a polar "snow cap," on January 26 and 28.

As stated on p. 121, the Director saw two brightish projections on the terminator, from E. *Hellas*, on November 3.

FIG. 38.—Dark knots, *f. Hellas*. 1911, November 14, $\omega = 305°$. (Phillips.)

The *mare* W. of *Hellas* showed three dark irregular condensations to Phillips on November 14 (Fig. 38).

YAONIS FRETUM was descried by transient glimpses in the $32\frac{3}{4}$-in. on November 13.

YAONIS REGIO had the 1909 form, at Meudon, and seemed whitish, when risen, to the Director, on December 23, and "bright white," at sunset, to McEwen on January 19.

MARE TYRRHENUM was, as a rule, faintish in 1911. McEwen dwells on its brown colour. According to Backhouse, McEwen, O'Hara, Phillips, Price, Thomson, and the Director, it was, as a whole, rather faint on September 3; darkish on September 4; faintish on September 5, 6, and 9; darkish on October 8 and 10; dark on October 11; utterly blotted out by white cloud, on October 14; faintish on November 9; darkish on November 10; faintish on November 13 and 14; darker perhaps on November 19; faintish on November 21; darkish on November 23; faintish on November 28; darkish on December 15; faintish on December 21 and 22; very faint, save to N.W., on December 23; darkish perhaps on December 26; faintish on December 28; darkish on December 30; faintish on January 3; darkish to W., faint to E., on January 28; darkish on February 2; and faintish on February 3 and 4. The extraordinary veiling of this *mare* through intensely white cloud, on October 14, has been dealt with on p. 124. But *Mare Tyrrhenum* was further veiled by yellow cloud, together with all S. lands and "seas" from *Eridania* to *Argyre*, in November,† and also partly in December, when its colour was a pale *olive* brownish grey, in the large instrument.

SYRTIS PARVA showed nothing unusual, and looked always faintish, at Meudon.

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* H. C. Wilson, in 1892, and Burton, in 1871, saw much the same thing here.

† *See* p. 123.

IAPYGIA is vaguely drawn by Phillips.

ŒNOTRIA was seen as a half-tone by McEwen, O'Hara, Phillips, and Thomson; but Backhouse, Price, and the Director barely indicate it.

DEPRESSIO IONICA is the name here given to an irregular dark spot, seen steadily S. of *Hellas*, in the $32\frac{3}{4}$-in., on November 6,

FIG. 39.—December 15, $\omega = 285° \pm$. (Phillips.)

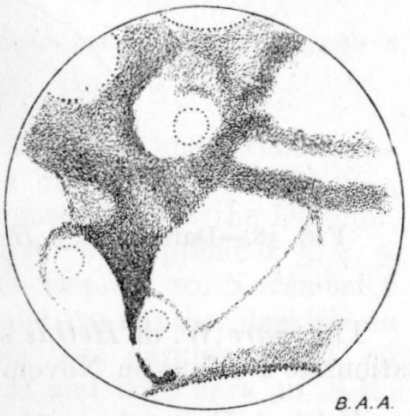

FIG. 40.—December 22, $\omega = 310° \pm$. (Thomson.)

The *Syrtis Major* region, in 1911.

7, 9, and 13 (Fig. 43), and which Phillips also drew on December 15 (Fig. 39).

A similar object was recorded at Meudon in 1909.*

LUNÆ PONS and *SOLIS PONS* of Lowell were seen by McEwen "traversing the S. end of *Syrtis Major* as brown "ochre streaks," on October 9 and on November 8. They were both noticed by O'Hara on September 3; but *Lunæ Pons* only was drawn by him on September 9 and on October 8. Thomson faintly represents *Solis Pons* on December 11 and 22. Backhouse, Phillips, and Price saw nothing here; and the Director unhesitatingly classes these objects in the category of those which vanish when scrutinized with a really powerful instrument under good conditions.

CROCEA is the name given to a dusky, yellow, triangular marking, which jutted out of *Libya*, in the direction of *Hammonis*

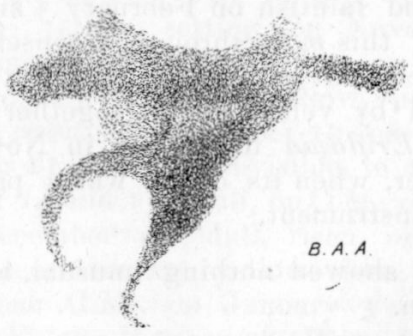

FIG. 41.—The half-tone *Crocea*. 1911, November 9. (Phillips.)

* *Mars Report* for 1909, p. 80 and Plate V. In 1856, Warren de la Rue and Brodie saw something akin to this.

Cornu. It was detected by the keen-sighted Phillips, on November 9 (Fig. 41), and announced, a fortnight later, to the Director, who had already seen it, independently, on November 13 (Fig. 43) and 14.

This feature might have been a detached mass of yellow cloud, and is so considered on p. 123; but it is curious that a similar half-tone was photographed more than once by Dr. Lowell in 1907,* although there was no trace of it visible in 1909.

INCURVA INSULA was caught in the $32\frac{3}{4}$-in., and looked like a meniscus, under slightly flickering images, on November 6, 9, and 13.

DELTOTON SINUS, considered as a single general concavity on *Aeria*, is drawn by Backhouse, O'Hara, Phillips, and Thomson; but, on November 13 and 14, the large instrument showed it compounded of three "bays," as at the previous apparition.

NYMPHÆUM PROMONTORIUM was more or less conspicuous to the above-mentioned five observers, its visibility naturally increasing with the aperture used.

A whitish tinge was seen here, at Meudon, on November 9.

SYRTIS MAJOR, as in 1909, did not present Lowell's form in 1911–1912. V-shaped to Backhouse (Fig. 51), McEwen (Fig. 42), O'Hara, and Price (Plate II., Fig. 5), it revealed more structure in the larger appliances of Phillips (Plate II., Fig. 3), Thomson (Plate II., Fig. 2), and of the Director (Fig. 43). According to these three observers, there was, first, a "bay" towards *Mœris Lacus;* then the great "sea" showed a blunted

FIG. 42.—*Syrtis Major* and its surroundings. 1911, September 4, $\omega = 264°$. (McEwen.)

angle to N., through the rounded outline of *Nili Sinus* and the presence of *Astusapis Sinus;* and finally receded at *Nymphæum Promontorium*. In the $32\frac{3}{4}$-in., it looked perhaps broader by $1\frac{1}{2}°$, or 2°, than in 1909, as if the dark material had encroached upon *Isidis Regio* since the last apparition. McEwen generally found the *Syrtis* "warm sepia," but "Delft blue" on November 8. At Meudon, it seemed of a steel grey colour, under tremulous definition. Its remarkable intensity was not uniform, Thomson recognising "a mottled appearance" here;

* *See* the Director's paper in *Monthly Notices*, R.A.S., Vol. LXIX., Plate 4, where the marking is identified with *Lunæ Pons.*

and it was darker to N. and to W. than to E. No trace of the half-tone *Arena* of 1909 could be descried with certainty. McEwen rightly remarks that *Syrtis Major* had a sharper outline to W. than to E. ; a statement which is countenanced by Phillips and by the Director. In this connection it is important to bear in mind that it is this ill-defined E. side of the *Syrtis*, not the W. one, that undergoes those remarkable periodical variations. During this apparition, the "Hour-Glass Sea" displayed a rather variable intensity. The drawings of Backhouse, McEwen, O'Hara, Phillips, Price, Thomson, and the Director, show that *Syrtis Major* was darkish on September 3 and 4 ; faintish on September 5, 6, and 9 ; darkish to W., faint to E., on October 10 ; darkish on November 6 ; faintish to S. on November 7 ; darkish on November 8 ; faintish on November 9 ; very dark to N., faintish to S., on November 10, 13, 14, and 19 ; darkish on November 22 ; darkish to N., on December 11 ; very faintish, save to N., on December 14 and 15 ; darkish on December 19 and 21 ; very dark, to N., on December 22 and 23 ; darkish on December 26 ; very dark, to N., on January 3 ; and very dark on January 28 and on March 15. We conclude that *Syrtis Major* was never very heavily effaced through yellow Martian cloud in 1911–1912.

NILI SINUS, broad, especially to Phillips and to the Director, was the darkest part of the *Syrtis*.

ASTUSAPIS SINUS was seized by Phillips and Thomson. On November 13, the Director saw this minute "inlet" as engraved

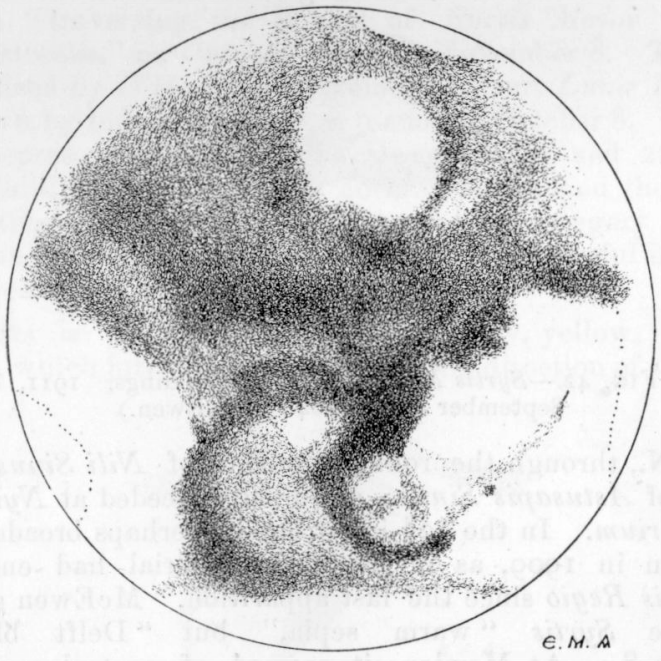

FIG. 43.—The *Syrtis Major* region, with *Libya*, *Mœris Lacus*, the conspicuous *Nepenthes-Thoth*, and the true form of the *Nilosyrtis*. 1911, November 13, $\omega = 282°$. (The Director, $32\frac{3}{4}$-in.)

on steel by applying a power of 810 on the great refractor (Fig. 43).

NILI PONS, repeatedly noted by Phillips (Fig. 39), and Thomson (Fig. 40), was vaguely made out, at Meudon, on December 21. Six days previously, Phillips had found it "sloping *n.p.*—*s.f.*"

LIBYA appeared strongly shaded, and was grey, not red, in 1911. Backhouse drew the half-tone on December 21; McEwen does not show it; O'Hara detected it on October 8; Phillips did not see it in October, but depicted it on all subsequent occasions; Price observed it on November 13; and Thomson and the Director never missed it. As in 1909, the $32\frac{3}{4}$-in. showed this shading to be very intense to W., and to extend as far as the *Nepenthes* and the *Triton* (Fig. 43).

The interposition of white cloud caused some transient brightenings of *Libya*. On September 4 and on October 10, this "land" was whitish on C.M. to McEwen; on October 11, brilliant white, when rising, to Phillips, to Stanley Williams, and to the Director; on October 14, it was again bright, on the limb, at Meudon; on October 15, it still rose bright, to McEwen; on December 11 it set white, with *Isidis Regio*, to Thomson; on December 15, it set brightish again, with *Isidis Regio*, to the Director; on January 28, it was white, on C.M., to McEwen; and, on February 2, it once more rose white, to the same observer.

The sparkling cloud formation over *Libya*, on October 11, has been alluded to on p. 124. In the $32\frac{3}{4}$-in., the whole country hereabout, as far N. as *Isidis Regio*, appeared patchy on that evening, and as if covered with innumerable white spots, all elongated by perspective near the full limb, and held steadily for some two seconds. The mottle given in Fig. 44 is necessarily everywhere inaccurate. Phillips wrote on October 11: "Amazing development of cloud over region of *Libya* since

FIG. 44.—Approximate appearance of *Libya* overspread with white flocculi. 1911, October 11, $\omega = 221°$. (The Director, $32\frac{3}{4}$-in.)

"I last saw Mars . . . . . When did this happen?" Also, "I have an entry (under date October 17th)," says Stanley Williams, "to the effect that about a week previously *Libya* "was seen exceedingly bright and white; like a bright island, "nearly midway between the central meridian and the preceding "limb of the planet. As Phillips writes that he saw much the

" same thing on October 11th, it is probable that my observation " was made on the same date. From the size of the bright " 'island' *Lacus Mœris*, etc., must have been quite covered, " and Phillips indeed states that this lake and *Nepenthes* were " quite blotted out."

MŒRIS LACUS, so huge in 1909, at Meudon, and on the photographs, was still quite large and conspicuous in 1911. But these abnormal dimensions seem to be inaccessible to small apertures. Backhouse did not represent the "lake"; McEwen drew it only once as a diminutive "estuary" on September 4 (Fig. 42); O'Hara showed it linear on October 8 (Plate II., Fig. 4); Phillips saw it dark after October, and measuring 14° from E. to W. and 6° from N. to S. (Figs. 39, 41, and Plate II., Fig. 3); Price found it like a "bight" of *Syrtis Major* (Plate II., Fig. 5); Thomson depicts it dark, and as an "inlet" of *Nepenthes*, 12° long, 3° wide to E., and 10° to W. (Figs. 40 and 53, and Plate II., Fig. 2); Stanley Williams described it "very large, and somewhat diffuse," on November 14. In November and December, the $32\frac{3}{4}$-in. gave to *Lacus Mœris* the form of an irregular, dusky parallelogram, 18° in length from E. to W., and 8° broad from N. to S. A slight trend from E.N.E. to W.S.W. was noted here, and the "inland sea" stretched on the S. side of the *Nepenthes*. It had a complex, lighter interior, due, probably, to the "island" and "peninsula" discovered in it at the previous apparition*; but the sedulous interrogation of these minute marks was most tantilizing in a rippling air.

Mœris Lacus, as already stated, was veiled completely by the wonderful white cloud area of October 11 (Fig. 44); but it does not seem to have been seriously obliterated by yellow cloud in 1911–1912.†

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* *Mars Report*, 1909, p. 83, and Plate V.

† This remarkable "lake," whose size was unnoticed by Schiaparelli and Lowell, often showed abnormal dimensions. The appended table will render this clear :—

Date.	η	Observer.	Appearance of *Lacus Mœris*.
1858, June 13	250	Secchi	Large and dark.
1862, Sept. 25	6	Lockyer	Very large, faint.
1862, „ 26	7	Schmidt	Very large and very dark.
1862, Oct. 3	11	Lockyer	Very large indeed, faint; made up of 3 parts (Fig. 45).
1862, „ 6	12	Earl of Rosse	Large, diffused, and very faint.
1862, Nov. 4	30	Lassell	Do. do.
1864, „ 26	67	Dawes	Large, oval, darkish (Fig. 46).
1864, Dec. 28	83	Kaiser	Large, diffused, very faint.
1873, May 24	231	Terby	Large and diffused.
1873, „ 28	233	Green	Large, oval, very faint (Fig. 47).
1875, June 23	270	Holden	A very dark, large "gulf."
1877, Sept. 10	347	Green	Large, very faint.
1877, „ 15	350	Do.	Do.
1879, Oct. 5	28	Burton	Large, oval, very faint (Fig. 48).
1881, Dec. 21	93	Niesten	Large and diffuse.

TRITONIS LACUS was indistinguishable, in the broadened *Nepenthes*, with the large telescope.

ISIDIS REGIO was strongly shaded in November and December. Notwithstanding the modesty of his instrument and the use of very high power, Backhouse did not miss the half-tone here

Footnote † continued from p. 160.

Date.	η	Observer.	Appearance of *Lacus Mœris*.
	°		
1884, Feb. 15	138	Trouvelot	Huge, oval, faint.
1884, ,, 17	139	Knobel	Very large and faint (Fig. 49).
1888, May 8	215	Perrotin	A huge dark "gulf."
1888, June 12	232	Do.	Do.
1892, July 27	308	Hussey	Large, round, dark.
1892, ,, 30	310	Do.	Do.
1907, ,, 11	287	Lowell, photograph.	Very large, faint, and diffused.
1907, ,, 24	294	Eddie.	Large "gulf."
1909, Sept. 20	358	Antoniadi	Huge, irregularly oval, darkish.
1909, ,, 28	3	Barnard, photograph.	Huge, oval, darkish (Fig. 50).
1909, Oct. 5	8	Hale, photograph.	Do. do.

In these data, as elsewhere in this Report, η stands for the heliocentric longitude of Mars.

Now, it will be noticed that the size of *Lacus Mœris* does not appear to be affected by the seasons of the planet.

Although the surface may, and probably does, change here, the temporary interposition of yellow cloud can explain many, if not all the variations

FIG. 45.—Lockyer, 1862.

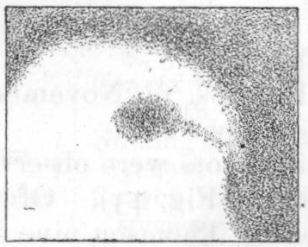

FIG. 46.—Dawes, 1864.

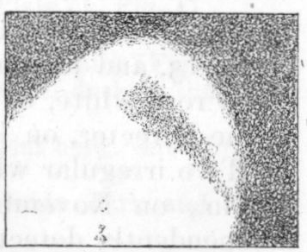

FIG. 47.—Green, 1873.

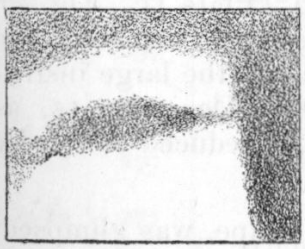

FIG. 48.—Burton, 1879.

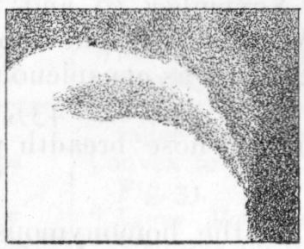

FIG. 49.—Knobel, 1884.

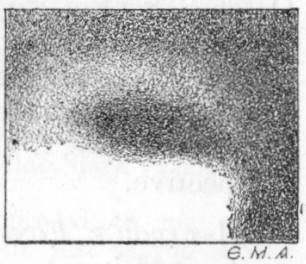

FIG. 50.—Barnard, 1909.

Some of the occasions on which *Lacus Mœris* showed abnormal dimensions in the past.

observed in the "lake." As Mr. Maunder laid it down, "sooner or later the old districts take on the old configuration" (*Knowledge*, 1894, p. 251); and these pithy words show us how clearly that distinguished astronomer grasped the Martian problem at a time when the commodities of all but a few were Schiaparelli-and-water.

(Fig. 51). In the $32\frac{3}{4}$-in., on November 7, 9, 13, and 14, the dusky area was quite remarkable, though perhaps inferior in tone to that of *Libya*; and it was noticed that there was no red tinge about it.

The S. part of *Isidis Regio* appeared veiled on October 11, by the bright cloud mass over *Libya*.

Nix Atlantica, admirably described as a "bright spot," by Thomson, on December 22, 26 (Fig. 53), and January 28, was well seen, at Meudon, on November 9, 13 (Fig. 43), 14, and December 23. It was somewhat oval, and measured 15° to Thomson, but 8° only to the Director, on account of greatly reduced diffraction in the large objective.

It must be pointed out that our *Nix Atlantica*, which Molesworth saw in 1898, Eddie in 1907, Phillips in 1909,* and Thomson and the Director in 1911–1912, is situated some 8° more to W. than the homonymous marking discovered and christened by Schiaparelli in 1877.

Neith Regio looked shaded to Phillips and to the Director. On October 8, O'Hara suspected a blue tinge here.

Nubis Lacus, distinguishable as the darkest part of the stripe *Thoth-Casius*, comes out well on the drawings of Backhouse (Fig. 51), Phillips (Figs. 39, 52, and Plate II., Fig. 3), Thomson (Fig. 53, and Plate II., Fig. 2), and of the Director (Fig. 43). Phillips calls it "an exceedingly dark "spot"; and, on December 26, Thomson wrote that it "was "extraordinarily dark and clear," and that it stood out "prominently on the disc" (Fig. 53).

Meroe appeared distinctly shaded, at Meudon, on November 9, 13, and December 23.

It rose white, to Phillips, on November 23, and set whitish, to the Director, on December 11.

Two irregular white spots were observed on *Meroe*, with the $32\frac{3}{4}$-in., on November 13 (Fig. 43). Of these, the S. one was independently detected by Thomson nine days later.

Coloe Palus is recognisable on Phillips's drawings of October 8 (Fig. 52), November 10 and 14 (Plate II., Fig. 3), as a dusky knob on *Nilosyrtis*, 6° in diameter. Thomson gave it 3°, on December 22. It was conspicuous, in the large instrument, on November 6, 9, 13 (Fig. 43), and December 15, as a dusky ellipse, 6° long, whose breadth was reduced to 3° by perspective.

Astaboræ Fons, on the homonymous stripe, was glimpsed, in the $32\frac{3}{4}$-in., as a diminutive blackish knot, $1\frac{1}{2}$° across, on November 13 (Fig. 43).

Utopia, grey to Phillips and to the Director, rose, on December 31, to Phillips, "so brilliant that it seemed to project "beyond the terminator."

* *Mars Reports* for 1898, 1907, and 1909, pp. 97, 99, and 83 respectively.

Uchronia, also shaded to these two observers, looked "especially bright," when rising, to Phillips and Thomson, on November 19.

Minor Detail.

Amenthes.—McEwen: February 2, width 4°, edge of white *Libya*.—Price: November 13, width 2°, prolongs *Thoth* to S.—Thomson: December 26, convex to W., 3° wide, faintish.

Astaboras.—Phillips: November 14, to E. only, 5° wide, very faint.—The Director: November 13, 14, to E. only, width 4°, very faint, diffuse.

Astusapes.—Phillips: October 8, November 10, faint smudge to S. only: November 14, "seen," convex to S.W., 5° wide, very faint.—Thomson: November 19, smudge to S. only; December 22, S. half only, convex to W., 2° wide, faintish.—The Director: November 9 and 13, convex to S.W., width 4° as a mean, edge of shaded *Meroe* (Fig. 43).

Borbyses.—The Director: November 9, concave to S.W., 4° wide generally, confused and diffused.

Nasamon.—McEwen: January 26, "clearly seen."—O'Hara: October 8, edge of shaded *Neith Regio*.—Phillips: November 14 and December 15, "glimpsed," edge of shade to N.W.

Nepenthes–Thoth–Casius.—The detailed observations concerning this remarkable streak are as follows:—

Date.	ω.	Observer.	Appearance of the Stripe.
1911.			
Sept. 3	264°	McEwen	Nothing visible.
,, 3	258	O'Hara	Do.
,, 5	290	Do.	Do.
,, 6	255	Do.	Do.
,, 9	251	Do.	Do.
Oct. 8	278	Do.	Do. (Plate II., Fig. 4).
,, 8	282	Phillips	*Nepenthes-Thoth* convex to E., visible to S., 5° wide, and very faint (Fig. 52).
,, 10	256	Do.	Convex to E., 4° wide, duskier than on the 8th.
,, 10	279 / 243	McEwen	Nothing seen, district hereabout whitish yellow.
Nov. 9	292	The Director	Convex to E., 7° wide, dark and conspicuous.
,, 10	287	Phillips	Convex to E., 4° wide, very dark and conspicuous.
,, 13	262	The Director	Convex to E., 7° wide, jagged, irregular, and dark.
,, 13	297	Price	Width 2°, prolongs *Amenthes* to N., held steadily (Plate II., Fig. 5).
,, 14	255	The Director	Convex to E., mean width 6°, irregularly ragged, and very conspicuous.
,, 14	277	Phillips	Convex to E., 5° wide, dark (Plate II. Fig. 3).
,, 14	277	Stanley Williams	"*Lacus Mœris* appeared to me with "p. 225 on 6½-in. just as you show "it in this drawing [from Prof. Barnard's photograph of 1909, September 28], very large, somewhat diffuse, and with *Libya* rather dark. "And the *Nepenthes* was *very broad*, "perhaps 2/3 the width of *Lacus* "*Mœris*. But *Nepenthes* was *clearly* "not uniform, but composed of faint "minor shadings."

Date.	ω.	Observer.	Appearance of the Stripe.
1911.			
Nov. 19	258°	Phillips	Convex to E., 5° wide, dark.
,, 19	260	Thomson	Convex to E., 3° wide, dark, "one of "the most interesting features of this "apparition."
,, 23	229	Phillips	Convex to E., 6° wide, dark.
Dec. 15	280	Do.	Convex to E., 4° wide, "fainter than "of late."
,, 17	—	Thomson	"Did not look so dark as on Novem- "ber 18."
,, 18	—	Do.	Do. do. do.
,, 21	255	Backhouse	Width 7°, dark and conspicuous (Fig. 51).
,, 22	295	Do.	Not drawn.
,, 23	259	The Director	Convex to E., 7° wide, diffused, dark.
,, 26	260±	Thomson	Convex to E., 3° wide, dark (Fig. 53).
,, 26	262	Backhouse	Width 8°, dark and conspicuous.
1912.			
Jan. 28	265±	Thomson	Convex to E., 4° wide, knotted, darkish (Plate II., Fig. 2).
,, 28	265	McEwen	Nothing drawn.
Mar. 5	—	Thomson	"Not seen."
,, 11	—	Do.	"Seen."

It will be found from these observations that the credit of the discovery of the abnormal darkness of the *Nepenthes-Thoth* belongs to Phillips, who first detected this band on October 8 (Fig. 52), when the planet was in $\eta = 35°$. The marking quickly increased in conspicuousness; and, during the November presentation, appeared quite dark. It then faded very slightly in December and January.

It is noteworthy that the intensification began after the disappearance of the great mass of white cloud over *Libya*; as if rain falling from the latter had fertilized the district. Curiously enough, something akin to this was seen by the unrivalled ability of Stanley Williams in 1894, when the planet was in about the same heliocentric longitude.*

Of the *Casius*, only the S.E. end was seen, emerging from the N. cloud area.

On December 26, January 27, and 28, Thomson "suspected a narrow "bright bridge across this marking, just S. of its junction with *Lacus* "*Nubis*."

FIG. 51.—The *Nepenthes-Thoth*. 1911, December 21, $\omega = 255°$. (Backhouse.)

* B. E. Cammel, *Mars Report* for 1894, pp. 121–122.

"The peculiarity," says Stanley Williams, "which struck me as im-
" portant, as bearing upon the real structure of the double *Nepenthes*,
" was that the irregular, faint, minor shadings were so arranged as to give
" rise to a feeble impression of duplicity to the broad streak composing the
" *Nepenthes*, as seen on November 14th. But everything was diffuse and

FIG. 52.—October 8, $\omega = 282°$. (Phillips.)

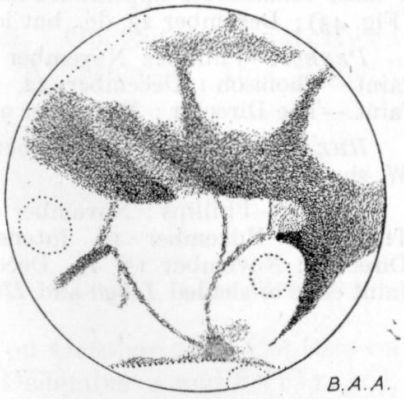

FIG. 53.—December 26, $\omega = 260° \pm$. (Thomson.)

Views of *Nepenthes-Thoth*, in 1911.

" irregular. Suppose, however, the planet to be at a greater distance, or a
" slight intensification of the details forming the broad *Nepenthes*, and
" we can understand how the intensely geminated aspect of the double
" *Nepenthes* might appear, as described by Schiaparelli and others; par-
" ticularly to an eye trained to slur over the minor irregularities of a (really)
" more or less diffused streak."*

NILOSYRTIS.—McEwen: November 8, to S. only, 5° wide, darkish.—O'Hara: October 8, edge of shade to N.E. and N.—Phillips: October 8, November 10, 14, 19, December 15, convex to N.E., $3\frac{1}{2}°$ wide, dark.—

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* In our 1909 Report, the deceitful phenomenon of the duplication of the markings was disposed of in eight lines and five diagrams (pp. 44–45 and Figs. 31–32 and 45–47). Gemination usually flashes along the edges of a broad, irregular stripe; but it may appear anywhere.

Nepenthes-Thoth was more or less easy to Niesten in 1882, to Denning in 1886, to Schiaparelli in 1890, and to Stanley Williams in 1894, but its grandest display in the past was that of 1888, when Mars was in $\eta = 210°$ to 256°. At that time, the band was dark to Niesten, blackish to Perrotin, and black to Holden (Figs. 54–56); and its intensity increased from April to July 1888.

FIG. 54.—Niesten, May 5.

FIG. 55.—Perrotin, May 8.

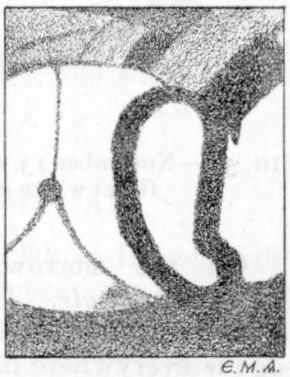


FIG. 56.—Holden, July 29.

Views of *Nepenthes-Thoth* in 1888.

Thomson : November 19, 22, January 28, convex to N.E., 3° wide, dark.—The Director : November 9, convex to E., 4° wide, very faint ; November 13, 14, in the $32\frac{3}{4}$-in., the true form of this famous stripe is revealed ; it reaches out of *Syrtis Major* with an almost E.N.E. trend, where it is 6° broad ; and then, narrowing to 5°, bends down at right angles to N.N.W. ; a most remarkable appearance of this dark object, held quite steadily (Fig. 43) ; December 23, do., but less dark, especially to N.W.

Peneus.—Phillips : November 14, December 15, to W. only, width 4°, faint.—Thomson : December 22, to W. only, convex to S.S.W., 3° wide, faint.—The Director : November 9, to W. only, 4° wide, amorphous, faint.

Rhesus.—Thomson : December 22 and 26, intensified edge of darkest W. shade of *Libya*.

Triton.—Phillips : November 19, 23, edge of *Hesperia* half-tone.—Thomson : November 19, intensified edge of *Hesperia* shading.—The Director : November 13, 14, December 23, convex to S.W., 3° wide, very faint edge of shaded *Libya* and *Hesperia*.

SECTION VII.

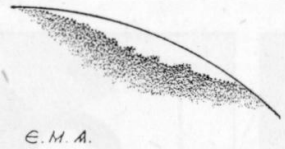
The South Polar Region.

$\Omega = 0°$ to $360°$; $\Phi = -60°$ to $-90°$.

Mare Australe is shown grey by the large majority of our Members. McEwen saw it usually brownish, and, on one occasion, "Delft blue." On September 18, O'Hara noted "a "faint dark greenish area" here. In the $32\frac{3}{4}$-in., *Mare Australe* looked pale, during the November yellow cloud formation between *Eridania* and *Thaumasia* ; but its E. end, to the S. of *Ausonia*, became dark on the partial withdrawal of the veil, on December 23.*

"Near S. pole," says McEwen, "a brilliant white spot was "visible on the limb," on November 8.

A vast white cloud area with exceedingly jagged borders to E., was held steadily, for 2 seconds, when rising in the great telescope, on November 13, from $\Omega = 340°$ westwards, and from $\Phi = -55°$ to $-82°$.



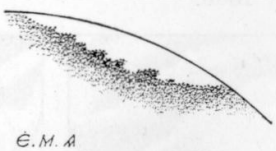


FIG. 57.—November 13, $\omega = 262°$. FIG. 58.—November 14, $\omega = 255°$.
Great white cloud area in the S. frigid zone of Mars.
(The Director.)

On the morrow, it had moved eastwards and attained *Novissima Thyle*. Owing to the impossibility of outlining and locating the indentations of this feature, its irregularly serrated edge is everywhere inaccurate, in Figs. 57 and 58 ; being merely destined to convey a general impression of its appearance. This

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* *See*, p. 123.

remarkable white mass did not escape the attention of Phillips, on the same dates.

McEwen saw another white patch, W. of *Argyre I.*, on January 14 and 19.

ARGYRE II. was a difficult object. On October 1, McEwen described it as "fully on disc." At Meudon, this "land"

FIG. 59.—*Argyre II.* 1911, December 6, $\omega = 62°$. (The Director.)

appeared of an ochre yellow colour, on October 28. Confuse on October 31, it was better seen on December 4 and 6 (Fig. 59), when it was ruddy and oval. But no trace of it was caught on January 13.

THYLE I. could not be observed otherwise than as an occasional marginal whitish spot. According to the joint results of McEwen, Phillips, and the Director, this "land" rose bright on December 4, 5, 6, and set bright on February 4 and March 15.

ULYXIS FRETUM, "clearly seen" by McEwen on November 25, December 28, and February 10, was visible at Meudon, as a dark swelling of *Mare Chronium*, on October 17. Yellow cloud blotted it out almost constantly, and particularly so on October 11.

THYLE II. was quite as indistinguishable as *Thyle I.* McEwen saw it "very white," rising, on November 24 and 25; "very bright," setting, on January 28; and again "very white," when rising, on February 4 and 10.

A white spot was drawn by Phillips, S. of *Hellas*, on November 19.

DEPRESSIONES HELLESPONTICÆ come out as a single dusky mark on Thomson's sketch of December 11. They were invisible to him on the following day, but reappeared very dark on December 19 and 22. At Meudon, they looked also as one grey spot, in a flaring image, on December 11, and were fainter three and four days later.

THE SOUTH POLAR SNOW CAP.

"The feature which has most struck me," says Hepburn, on August 15, "is the contrast between the appearance of the S. "polar snow cap in June and early in July (when it was "conspicuous) and its appearance in the last few weeks, when "I have hardly been able to see it."

A study of the observations of all Members having sent in drawings leads to the following conclusions regarding the appearance of the S. polar regions: There was a large whitish

area here on August 8, 11, and 15; nothing on August 16; again an extensive dull white spot on August 17; the snow cap flashed forth, measuring 21° across, on August 23; reappearance of the large whitish area on August 27, and on September 3 and 4; nothing hereabout on September 5 and 6; the cap measured 15° on September 8; it was invisible on September 9; it was 16° across on September 18; there was nothing here on September 20; the cap measured 9° on September 21; a large whitish area reappeared on September 23, 25, 29, and on October 1; nothing was discernible at the pole on October 2 and 8; a large *yellowish* marking covered the frigid zone on October 10; a whitish glimmer was seen on October 11; *yellow* material was again prevalent here on October 14; there was a dull whiteness on October 15 and 17; a small cap, 6° in diameter, appeared on October 20; this had 11° on October 28, 30° on October 31, 10° on November 3, 7° on November 6, and 10° on November 7; again there was nothing hereabout on November 8; a cap of 12° was visible on November 9, and of 13° on November 10; nothing again could be detected on November 13; the cap was 10° across on November 14 and 19; it was not seen on November 21 and 22; it measured 9° on November 23; it could not be made out on November 24 and 25; it was 8° across on November 28, 5° only on December 4, and 6° on December 5 and 6; there was no snow to be seen on December 7; a dull area covered the pole again on December 11 and 12; the cap measured 8° on December 14; a faint glare only was noted on December 15; there was nothing about the pole on December 19 and 21; a dull marking was recorded on December 22 and 23; nothing could be detected here on December 25 and 26; a large whitish area was again seen on December 28; nothing visible on December 30 and on January 3; the cap was "brighter than usual" on January 5; a dull whitish area lay again about the pole on January 7, 13, 14, 19, 28, February 2, 3, and 4; a larger whitishness was observed on February 10 and 20; and there was once more nothing at the pole on March 15.

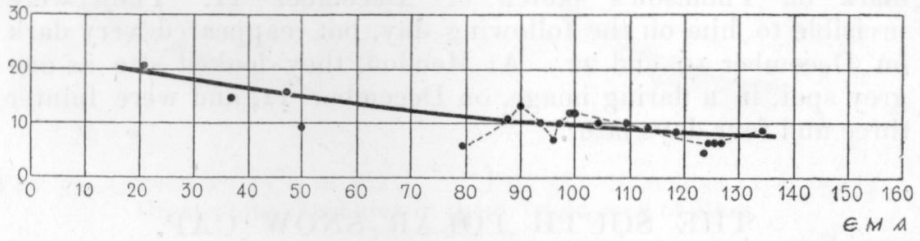

FIG. 60.—Diminution in area of the S. polar cap of Mars in 1911.

Hence 21 days after the summer solstice of the S. hemisphere the cap measured 21°, whereas, 134 days after the solstice, it still subtended 8° (Fig. 60). Thus the S. snow cap was followed as far as $\eta = 73°$, longer than on any other occasion. In 1909, it was last seen in $\eta = 46°$; in 1894 in $\eta = 42°$; and in 1862 in $\eta = 53°$.

The snows were often veiled by dull whitish cloud ; and, on October 10 and 14, we even witnessed the interposition of *yellow* cloud.

On September 14, at 15^h 20^m, McEwen saw "a bright "round spot," separated from the *f.* end of the cap. Two days later, he was struck by "a brilliant white patch bordering the S. "limb with the detached bright spot."

SECTION VIII.

The North Polar Region.

$\Omega = 0°$ to $360°$; $\Phi = +60°$ to $+90°$.

The joint results of Backhouse, McEwen, O'Hara, Phillips, Price, Thomson, and the Director show, first, that there was nothing noteworthy in the N. frigid zone on August 8, 11, 15, 16, 17, 23, 27, September 3, 4, 5, 6, 8, and 9. On September 18, a dull whitishness covered this area, and had a diameter of 60° ; this was not seen on September 20 and 21 ; it then reappeared, measuring 65° on September 23 and 25, 50° on September 29 ; it was again invisible on October 1 and 2 ; measured 53° on October 8 ; 58° on October 10 ; 50° on October 11 ; 53° on October 14 and 15 ; 60° on October 17 ; 50° on October 20 ; 60° on October 28 ; 68° on October 29 ; 48° on October 31 ;

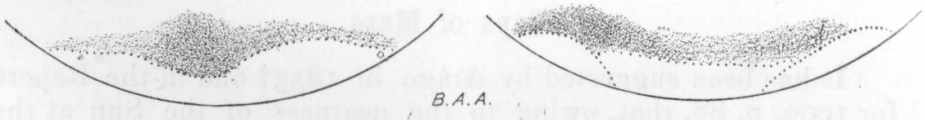

FIG. 61.—*Mare Acidalium*, notching the white area to N. December 12, $\omega = 28°$. (Backhouse.)

FIG. 62.—*Propontis*, and bright white spots near it. November 24, $\omega = 220°$. (Phillips.)

Phenomena seen in the N. polar regions of Mars, in 1911.

60° on November 3, when it covered part of *Mare Acidalium ;* 80°, extending over *Niliacus Lacus* and *Mare Acidalium*, on November 6 ; 75°, with the same extension, on November 7 ; 51° on November 8 ; 65° on November 9 and 10, when it again stretched beyond *Mare Acidalium* and *Niliacus Lacus ;* 67° on November 13 ; 57° on November 14 ; 60°, with the *f.* part very bright, on November 19 ; 40° on November 21 ; 55° on November 22 and 23 ; 47° on November 24 ; 50° on November 25 ; 35° on November 28 ; 85° on December 3, blotting out *Mare Acidalium ;* 70° on December 4, concealing the same *mare ;* 73° on December 5 and 6, when it again covered that "sea" ; 55° on December 7 ; 65° on December 11, once more obliterating *Mare Acidalium ;* 60°, with the same blotting, on December 12 ; 80°, again covering the *mare*, on December 14 and 15 ; 42° on December 19 ; 35° on December 21 ; 50° on December 22 ; 60° on December 23 ; 44° on December 25 ; 48° on December 26 ; 55° on December 28 ; the whitishness was

again invisible on December 30 and January 3; it subtended 60° on January 7 and 13; was seen as a diffused glimmer on January 14 and 19; had 38° on January 28; was noted as a whitish area, with ill-defined edges, on February 2, 3, and 4; concealed once more *Mare Acidalium* and *Niliacus Lacus* on February 20; and finally measured some 50° across on March 15.

It seems that this vast dull white mark was largely due to cloud, which probably covered the N. snows. The latter, visible now and then, constituted the brilliant spots seen in it. At Meudon, the yellow atmospheric element on Mars was prevalent over the whitish material on November 14, December 4, 6, 11, 14, 15, and 23. There was a lemon colour here on December 4, whereas, on December 14, the brightest mass was lemon to left, white to right.

"A very bright patch . . . . within the N. polar cap," was observed by Thomson on November 19.

Backhouse saw the white area indented by *Mare Acidalium* on December 12 (Fig. 61); and Phillips was struck by two brilliant patches in the dull whitish material, on November 24 (Fig. 62).

The whitenesses over the N. frigid zone were abnormally numerous and extensive in 1911–1912, almost rivalling the appearances of 1864.*

Phenomena concerning the Melting of the Polar Snow Caps of Mars.

It has been suggested by Arago in 1853† and in the Report for 1909, p. 88, that, owing to the nearness of the Sun at the summer solstice of the S. hemisphere of Mars, the S. snow cap ought to melt more quickly than the N. one. Now, tested by the analysis of all published drawings since 1856, this necessity has been confirmed in a striking manner, as—

I. *The S. snow cap may be visible from* $\eta = 250°$ *to* $\eta = 74°$, *hence for* 311 *days, disappearing from sight, when melting slowly, some* 136 *days after the S. summer solstice.*

II. *The N. snow cap may be visible from* $\eta = 50°$ *to* $\eta = 270°$, *hence for* 457 *days, disappearing from sight, when melting slowly, some* 188 *days after the N. summer solstice.*

III. *Hence, owing to the nearness of the Sun at the summer solstice of the S. hemisphere of Mars, the melting of the S. snow cap goes on more rapidly than that of the N. one, and in the approximate ratio of* 2 *to* 3.

Also—

IV. *On emerging from the dark hemisphere, the S. snow cap is larger than the N. one, as forming in a longer winter.*

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* The N. snow cap melted quickly in 1886.

† *Astr. Pop.*, Vol. IV., p. 135.

Further—

V. *The melting of the polar caps is rendered irregular—*

(*a*) *By white cloud, floating over the snows, and partly checking solar radiation;*

(*b*) *By local causes, beyond our grasp; and, probably,*

(*c*) *By the state of the Sun; a maximum of sunspots usually coinciding with a rapid melting, a minimum with a slow melting, of the snows.**

The last inference thus probably furnishes us with an independent proof of the accuracy of the discovery made by Langley, that, when sunspots are most numerous, the generally disturbed condition of the photosphere is necessarily accompanied by an increased radiation of the Sun.

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* Owing to the high diathermancy, and frequent cloudlessness, of the Martian atmosphere, variations in the intensity of solar radiation must be much more sensible on Mars than on the Earth. The Director detected the agreement between the melting snows of the planet and the solar cycle on 1916, April 30, and forthwith communicated the result to Mr. Maunder. During a conversation held on the subject on 1916, May 22, the Director was glad to find that his friend, Abbé Moreux, expected such a relation between the two phenomena, as well as other manifestations, on Mars, of the maxima and minima of sunspots.

PART III.

CHARACTERISTICS OF THE 1911–1912 APPARITION.

A summary of the most striking features of the opposition may be given as follows :—

(1) The extraordinary development and conspicuousness of the dusky stripe *Nepenthes-Thoth ;*

(2) The concomitant darkness of *Nubis Lacus ;*

(3) The vast size of *Lacus Mœris ;*

(4) The strong shading of *Libya* and *Isidis Regio ;*

(5) The comparative narrowness of *Syrtis Major ;*

(6) The brown colour of *Campi Phlegræi*, of *Xanthe*, and of *Lunæ Lacus*, whose nature must radically differ from that of the other dusky markings ;

(7) The faintness of *Pandoræ Fretum ;*

(8) The great white cloud formation over *Libya*, *Mare Tyrrhenum*, *Hesperia*, and *Mare Cimmerium*, in October ;

(9) The white cloud over *Mare Acidalium ;*

(10) The pallor of the *maria* and the yellowness of all S. lands between *Ausonia* and *Argyre* in November and December ;

(11) The darkness and length of *Solis Lacus ;*

(12) The faintness of *Mare Acidalium ;*

(13) The 1909 form of *Aonius Sinus ;*

(14) The duskiness of *Icaria ;*

(15) The duskiness of *Eridania ;*

(16) The visibility, as in 1907, of *Crocea ;*

(17) The visibility of *Depressio Ionica ;*

(18) The darkness of *Cerberus I ;*

(19) The veiling of *Phœnicis Lacus ;*

(20) The dimness of *Thyle Insulæ ;*

(21) The smallness and frequent veiling of the S. polar cap ;

(22) The immense white material which usually covered the whole of the N. frigid zone of the planet ;

(23) The projections seen on the terminator ;

(24) The detection of the true form of the *Nilosyrtis*, which reaches out of *Syrtis Major* to E.N.E. in order to bend down at right angles to N.N.W. ;

(25) The constant visibility of *Candor*, in the $32\frac{3}{4}$-in. ;

(26) The visibility of *Chrysokeras;*

(27) The visibility of *Symplegades Insulæ;*

(28) The visibility of *Hyria Lacus;*

(29) The visibility of *Argyre II;*

(30) The 1909 form of *Thaumasia;*

(31) The complex structure of *Tithonius Lacus*, and the blackishness of some of the "lakes" of which it is compounded;

(32) The blackness of *Juventæ Fons;*

(33) The tapering outline, to N.W., of *Mare Cimmerium;*

(34) The triple structure of *Deltoton Sinus;*

(35) The protrusion of *Nymphæum Promontorium;* and

(36) The visibility of *Nix Atlantica.*

In concluding this Report, we must express our sense of deep gratitude to Dr. Henri Deslandres, of the French Academy of Sciences, Associate and Gold Medallist of the Royal Astronomical Society, for the hearty support he has given to the Mars Section of the Association by allowing once more the use, on the planet, of the great refractor of the Meudon Observatory.

Paris, 74, Rue Jouffroy,
1916, March 14.

E. M. ANTONIADI,
Director of the Section.

APPENDIX.

THE PHENOMENA OF THE MARTIAN YEAR.

A diary of the appearances to be observed annually on Mars would be useful to the student, as well as to the areographer. The following table, based on the Director's examination of all trustworthy* drawings published from 1856 to 1912, will meet this requirement.

The first column here gives the heliocentric longitude (η) of Mars, while the second, headed B, shows the height of the Sun above the S. (−) and N. (+) poles of the planet. The dimensions of the polar caps are those of the normal of 57 years.

η	B	Phenomena.
0°	− 24°	S. polar cap subtends 14°; whitenesses in S. polar zone are rare here, although they may stretch sometimes over more than 40°.—N. polar cap invisible; rare whitishnesses can extend occasionally in the N. polar zone over more than 70° of the limb.—*Syrtis Major* very narrow hereabout.
10°	− 24°	S. cap subtends 12°; S. whitenesses are rare, but may at times cover more than 30°.—N. whitenesses are rather rare, yet extending now and then over more than 40° on the limb.
20°	− 22°	S. cap subtends 10°; S. whitenesses are rare, but can cover sometimes 40° or more.—N. whitenesses are rather rare, stretching occasionally over 70° or more on the limb.
30°	− 20°	S. cap becomes a difficult object and may soon vanish from sight, yet can subtend 9°; S. whitishnesses are rare, but may cover occasionally 40° or more.—N. whitenesses are rather frequent here, extending now and then over more than 65° on the limb.—*Syrtis Major* narrow.
40°	− 18°	S. cap difficult, can still subtend 8°, or may cease to be visible; S. whitisbnesses are always rare, but can cover sometimes 40° or more.—N. whitenesses are frequent, often extending over more than 65° on the limb.—*Syrtis Major* narrowish.—The deportment of the *Nepenthes-Thoth* can be interesting hereabout.
48° 54′	− 15°	Mars in ☌.
50°	− 14°	S. cap very difficult, can still subtend 7°, or may have disappeared from sight; S. whitenesses are rare, but may subtend more than 20°.—N. cap reappears; N. whitenesses are frequent, stretching at times over more than 80° on the limb.
60°	− 11°	S. cap very difficult, may still subtend 6°, or may have vanished from sight; S. whitenesses are rare, yet can cover sometimes more than 50°.—N. cap visible; N. whitenesses are frequent, extending now and then over more than 75° on the limb.—*Syrtis Major* tends to widen.

* The work done at Barcelona, Lussinpiccolo, and Copenhagen has been rejected from this investigation.

η	B	Phenomena.
70°	− 7°	S. cap exceedingly difficult, may still subtend 5°, if it has not disappeared ; S. whitenesses are rare, but can cover more than 50° at times.—N. polar cap is now clearly seen, subtending some 45° ; N. whitenesses are frequent, stretching occasionally over 90° or more on the limb.—*Mare Acidalium* may look blackish here.
75°	− 5°	S. polar cap definitely ceases to be accessible to our appliances, and may sometimes melt entirely after a maximum theoretical visibility of 311 days, and some 136 days after the S. summer solstice.
80°	− 3°	S. whitenesses are rare, although they may cover at times 35° or more.—N. cap subtends 44° ; N. whitenesses are frequent, extending now and then over more than 95° on the limb.—*Syrtis Major* broadish.
87°	0°	Autumnal Equinox of S. hemisphere : S. pole passes in the dark hemisphere.—Vernal Equinox of N. hemisphere : N. pole emerges from the dark hemisphere.
90°	+ 1°	S. whitishnesses are rare, but may on occasions extend over 40° or even more on the limb.—N. cap subtends 43° ; N. whitenesses are frequent, stretching sometimes over more than 95°.
100°	+ 5°	S. whitenesses are rare, although covering occasionally more than 45° on the limb.—N. cap subtends 42° ; N. whitenesses are frequent, extending now and then over 75° or even more.—*Syrtis Major* broad hereabout.
110°	+ 9°	S. whitenesses become very rare, but may sometimes cover 40° or more on the limb.—N. cap subtends 40° ; N. whitenesses are frequent, extending at times over more than 60°.—*Mare Acidalium* may always look very dark.
120°	+ 13°	S. whitishnesses are still very rare ; but can stretch over more than 30° at times on the limb.—N. cap subtends 37° ; N. whitenesses are frequent, covering occasionally more than 60°.—*Mare Acidalium* may appear very dark.
130°	+ 16°	S. whitenesses are rare, but occasionally they may spring to an apparent diameter of 90° on the limb.—N. cap subtends 34° ; N. whitenesses are frequent, stretching sometimes up to 55° or more.—*Mare Acidalium* may look very dark.
140°	+ 19°	S. whitenesses are rare, although covering sometimes more than 35° on the limb.—N. cap subtends 31° and melts quickly ; N. whitenesses are frequent, often extending over 50° or more.—*Syrtis Major* broad.
150°	+ 21°	S. whitenesses are rare, but may subtend 40° or more at times on the limb.—N. cap subtends 27° ; N. whitenesses are frequent, and can stretch over more than 70° at times.
154° 31′	+ 22°	Mars in Aphelion.
160°	+ 23°	S. whitenesses are rare, although covering sometimes 60° or more on the limb.—N. cap subtends 24° ; N. whitenesses are frequent, and can extend now and then over more than 65°.
170°	+ 24°	S. whitenesses are very rare, yet they can occasionally cover 50° or more on the limb.—N. cap subtends 21° ; N. whitenesses are frequent, and may cover at times more than 65°.—*Syrtis Major* very wide.
177°	+ 24°	Winter Solstice of S. hemisphere ; Summer Solstice of N. hemisphere.

η	B	Phenomena.
180°	+ 24°	S. whitenesses are rare, but may cover at times more than 55° on the limb.—N. cap subtends 18°; N. whitenesses are frequent, extending now and then over more than 50°.—*Mare Acidalium* may always appear very dark hereabout.
181°	+ 24°	A brilliant snow mass, *Olympia*, detaches itself from the N. polar cap, its centre being in Ω = 210° ±, and Φ = + 79° ±.
190°	+ 24°	S. whitenesses are rare, yet they may cover sometimes 65° or more on the limb.—N. cap subtends 16°; N. whitenesses are frequent, and may occasionally extend over more than 40°.
200°	+ 22°	S. whitenesses are rare, but may measure at times 60° or more on the limb. N. cap subtends 14°; N. whitenesses are frequent, often covering more than 40°.—*Syrtis Major* very wide.
210°	+ 20°	S. whitenesses are rare, although they may cover sometimes more than 45° on the limb.—N. cap subtends 12°, becomes a difficult object, and may soon vanish from sight; N. whitenesses are frequent, often stretching over more than 35°.
220°	+ 18°	S. whitenesses are rare, but may at times measure more than 40° on the limb.—N. cap difficult, may subtend 11°, or may have ceased to be visible; N. whitenesses are frequent, and may on occasions cover more than 30°.—*Mare Acidalium* may still appear very dark.
228°	+ 16°	N. snow cap may appear, in large instruments, divided by a rift running from Ω = 140° ± to 320° ±.
228° 54′	+ 14°	Mars in ☍.
230°	+ 14°	S. whitenesses are rare, but may cover now and then more than 40° on the limb.—N. cap difficult, may subtend 10°, or may have already ceased to be accessible to our telescopes; N. whitenesses are frequent, often extending over more than 70°.—*Syrtis Major* very broad indeed here.
240°	+ 11°	S. whitenesses are rare always, but may measure occasionally more than 40° on the limb.—N. cap very difficult, may still subtend 9°, or can have vanished from our view; N. whitenesses are frequent, often covering more than 40°.—*Syrtis Major* still very wide hereabout.
250°	+ 7°	S. polar cap reappears and may be caught here; S. whitenesses are rare, yet they may cover more than 50° at times on the limb.—N. cap very difficult always, may still subtend 8°, if it has not already disappeared from sight; N. whitenesses are frequent, subtending now and then more than 40°.—*Mare Acidalium* may still appear dark.
253°	+ 4°	*Olympia* ceases to be visible, after remaining in sight theoretically for 147 days.
260°	+ 3°	S. cap visible; S. whitenesses are rare, yet they may stretch occasionally over more than 60° on the limb.—N. cap exceedingly difficult, if at all visible, may still subtend 7°; N. whitenesses are frequent, often extending over more than 45°.—*Syrtis Major* very wide always.
265°	+ 1°	S. polar cap is now visible quite distinctly, subtending nearly 53°, more than the N. cap at its reappearance, owing to the longer S. winter of Mars, which lasts 381 days, instead of the 306 days of the N. winter.

η	B	Phenomena.
267°	0°	Vernal Equinox of S. hemisphere: S. pole emerges from the dark hemisphere.—Autumnal Equinox of N. hemisphere: N. pole passes in the dark hemisphere.
269°	− 1°	S. cap shows a bay towards $\Omega = 340° \pm$.
270°	− 1°	S. cap subtends almost 53°; S. whitishnesses are rare, yet they may cover sometimes 50° or more.—N. cap almost invisible, but, if seen, may be noted as subtending 6°; N. whitenesses are frequent, often stretching over 40° or more on the limb.—*Syrtis Major* wide, tends to shrink to left.
271°	− 2°	N. polar cap definitely ceases to be accessible to our appliances, if it has not vanished from sight long before this, the disappearance occurring after a maximum theoretical visibility of 457 days, and some 188 days after the N. summer solstice.
280°	− 5°	S. cap subtends almost 52°; S. whitenesses are rare, but may occasionally cover more than 60°.—N. whitenesses are frequent, stretching sometimes over more than 40° on the limb.—*Syrtis Major* widish.
290°	− 9°	S. cap subtends almost 50°; S. whitenesses are rare, although at times they may cover 60° or even more — N. whitenesses are frequent, often subtending 50° or more on the limb.—*Syrtis Major* widish, narrows rather quickly here.
292°	− 10°	A dark, ruddy spot, *Magna Depressio*, appears in the S. cap, in $\Omega = 270° \pm$ and $\Phi = -80° \pm$.
298°	− 12°	A dark rift, *Rima Australis*, connected with *Magna Depressio*, appears running from $\Omega = 20° \pm$ to 200° ±, in the S. cap. The smaller segment of the snows thus divided lies in the direction of *Syrtis Major*, and covers the region of *Novissima Thyle*.
300°	− 13°	S. cap subtends 45°; S. whitenesses are rare, but may occasionally measure 60° or more.—N. whitenesses are frequent, often stretching over more than 50° on the limb.—*Syrtis Major* rather narrowish.
302°	− 14°	A sparkling white spot may be seen in S. cap, in the position of *Novissima Thyle*.
305°	− 15°	*Novissima Thyle* assumes the appearance of a promontory of the S. cap.
306°	− 15°	A second dark rift, *Rima Angusta*, appears furrowing the S. cap from $\Omega = 90° \pm$ to 270° ±.
310°	− 16°	S. cap subtends 40°, melts quickly, and shows several dark spots in it; S. whitishnesses are rare, but may sometimes cover 60° or more.—N. whitenesses are always frequent, extending at times over more than 45° on the limb.—*Syrtis Major* narrowish.
311°	− 16°	S. cap presents a cape in $\Omega = 155° \pm$.
319°	− 19°	*Novissima Thyle* detaches itself clearly, as a bright snow mass, from the S. cap, while *Rima Australis* broadens, and *Magna Depressio* becomes a mere gulf.
320°	− 19°	S. cap subtends 34°, and melts very quickly here; S. whitishnesses are very rare, but may stretch sometimes over more than 60°.—N. whitenesses are frequent, often covering 40° or more on the limb.—*Syrtis Major* narrow.
323°	− 19°	A starlike point may be caught N. of *Novissima Thyle*. S. cap shows two capes in $\Omega = 30° \pm$ and 40° ±.
326°	− 20°	*Magna Depressio* is invisible even as a gulf of the S. cap.

η	B	Phenomena.
327°	− 20°	*Novissima Thyle* narrows, and assumes the form of a cigar, concentric with the S. cap, while *Rima Australis* widens into a broad channel.
330°	− 21°	S. cap subtends 27°, melting quickly; S. whitishnesses are very rare, but can cover sometimes more than 60°.—N. whitenesses are rather rare, yet they may spread occasionally over more than 35° on the limb.—*Syrtis Major* very narrow.
332°	− 21°	The promontory detected in the S. snow cap, towards $\Omega = 155° \pm$, under $\eta = 311°$, now looks like an isolated bright spot.
334° 31′	− 22°	Mars in Perihelion.
340°	− 23°	S. cap subtends 22°, and still melts quickly; S. whitishnesses are rare, yet covering on occasions more than 60°.—N. whitenesses are also rare here, subtending at times 55° or more on the limb.—*Novissima Thyle* tends to become starlike with adjoining bright specks.—*Syrtis Major* very narrow.
346°	− 24°	*Novissima Thyle* is reduced to a few bright dots.
348°	− 24°	No trace of *Novissima Thyle*.
350°	− 24°	S. cap subtends 17°; S. whitishnesses are rare, yet they may cover at times more than 60°.—N. whitenesses are also rare, although they may occasionally extend over 35° or more on the limb.—*Syrtis Major* very narrow.
357°	− 24°	Summer Solstice of S. hemisphere; Winter Solstice of N. hemisphere.
360°	− 24°	S. cap subtends 14°; S. whitenesses are rare, but may cover occasionally 40° or more.—N. whitenesses are also rare, yet they can extend at times over more than 70° on the limb.—*Syrtis Major* very narrow.

Such a collation of the principal phenomena of the Martian year enables us to grasp them much more firmly than in the past. On the approach of an apparition, the student will have simply to look, in the "Nautical Almanac," for the successive heliocentric longitudes through which Mars is going to pass, and to wait for those remarkable occurrences, which are sure to come with an almost mathematical regularity. The British 12½-in. reflector is the most practical instrument to be used in this enquiry, on account of its low price, handiness, and resolving power.

E. M. ANTONIADI,
Director of the Section.

1916, May 12.

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FIG. 1.—E. M. ANTONIADI. $32\frac{3}{4}$-in. O.G.
1911, December 11. $\omega = 8°$, $\phi = -13°{\cdot}6$.

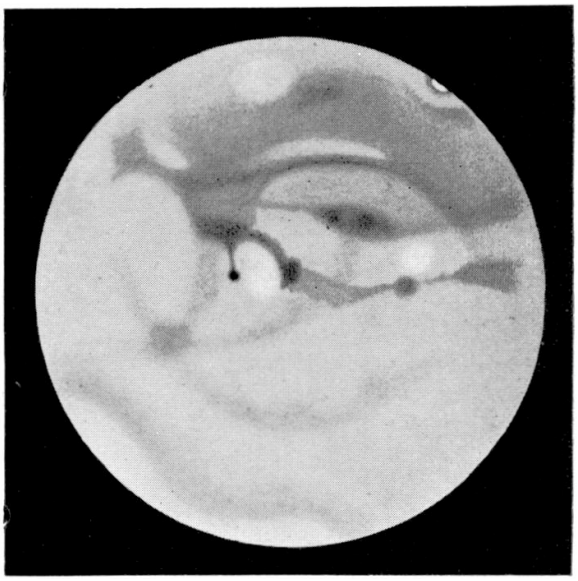


FIG. 2.—T. E. R. PHILLIPS. $12\frac{1}{4}$-in. Spec.
1911, December 3. $\omega = 79°$, $\phi = -12°{\cdot}5$.

FIG. 3.—E. M. ANTONIADI. $32\frac{3}{4}$-in. O.G.
1911, December 4. $\omega = 87°$, $\phi = -12°{\cdot}7$.

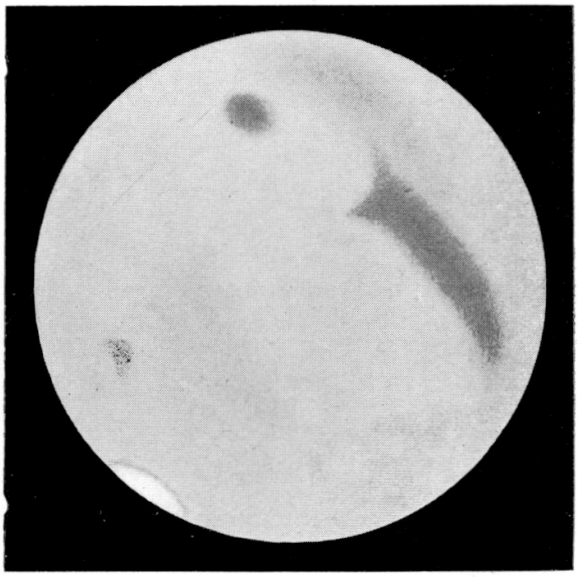


FIG. 4.—T. W. BACKHOUSE. $4\frac{1}{4}$-in. O.G.
1911, November 28. $\omega = 129°$, $\phi = -11°{\cdot}7$.

FIG. 5.—E. M. ANTONIADI. $32\frac{3}{4}$-in. O.G.
1911, October 17. $\omega = 152°$, $\phi = -5°{\cdot}5$.

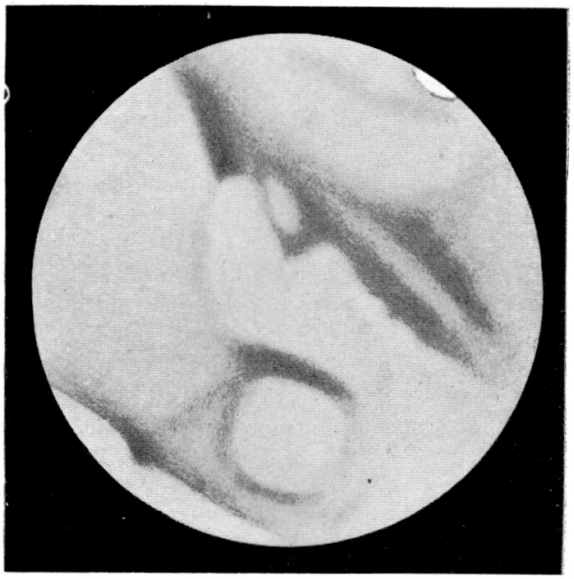


FIG. 6.—T. E. R. PHILLIPS. $12\frac{1}{4}$-in. Spec.
1911, November 22. $\omega = 185°$, $\phi = -10°{\cdot}5$.

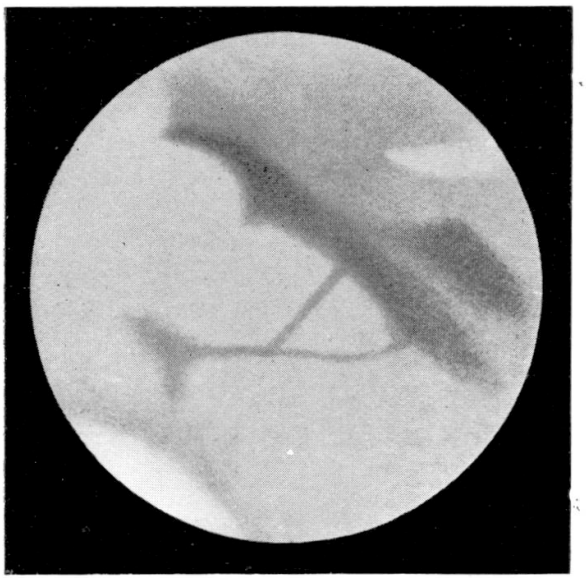


FIG. 1.—H. MCEWEN. 5-in. O.G.
1911, November 21. $\omega = 217^{\circ}$, $\phi = -10^{\circ}\cdot2$.

FIG. 2.—H. THOMSON. $12\frac{1}{2}$-in. Spec.
1912, January 28. ω 260° ±, $\phi = -12^{\circ}\cdot9$.

FIG. 3.—T. E. R. PHILLIPS. $12\frac{1}{4}$-in. Spec.
1911, November 14. $\omega = 277^{\circ}$, $\phi = -9^{\circ}\cdot0$.

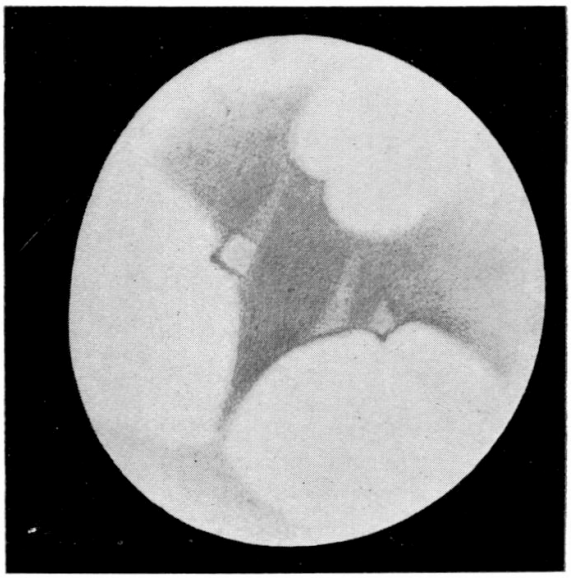


FIG. 4.—C. O'HARA. $8\frac{1}{6}$-in. Spec.
1911, October 8. $\omega = 278^{\circ}$, $\phi = -5^{\circ}\cdot5$.

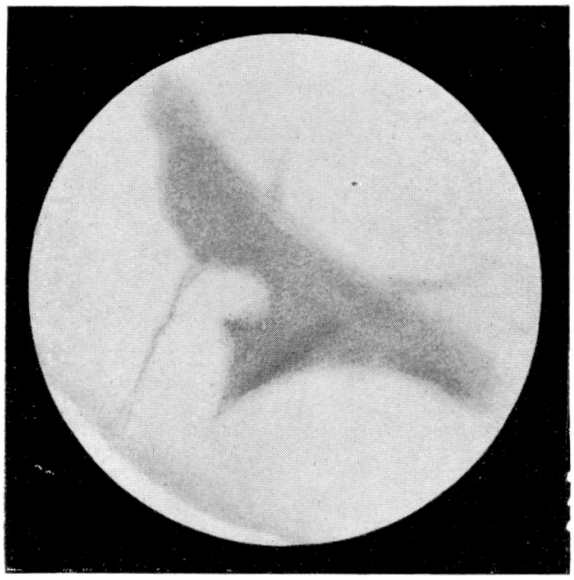


FIG. 5.—W. S. PRICE. $8\frac{1}{2}$-in. Spec.
1911, November 13. $\omega = 297^{\circ}$, $\phi = -8^{\circ}\cdot7$.

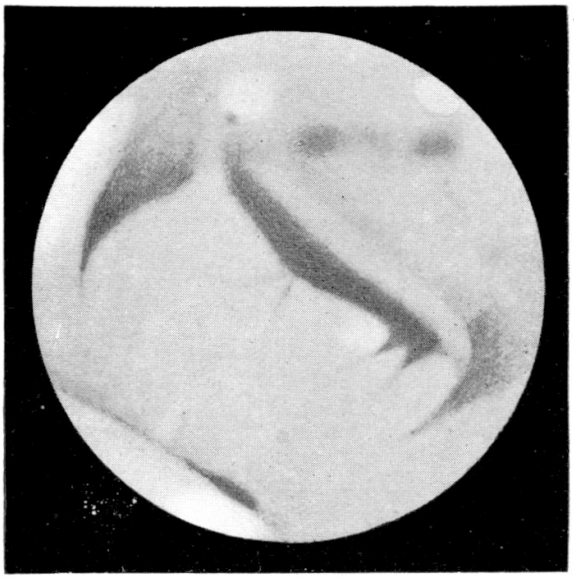
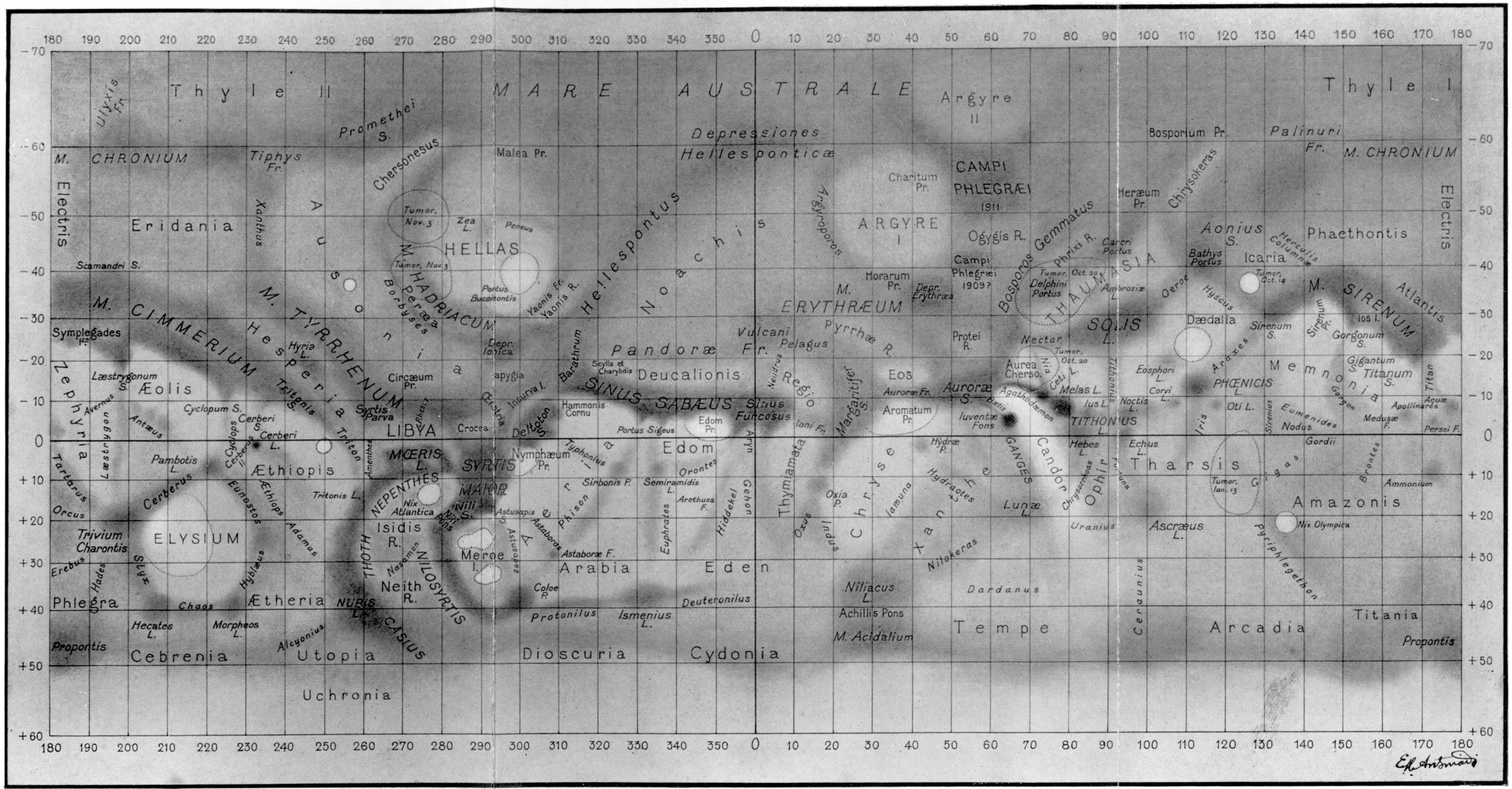


FIG. 6.—H. THOMSON. $12\frac{1}{2}$-in. Spec.
1911, December 11. $\omega = 330^{\circ}$ ±, $\phi = -13^{\circ}\cdot6$.

SOUTH.

EAST.



WEST.

NORTH.

CHART OF MARS ON MERCATOR'S PROJECTION.

PREPARED FROM THE OBSERVATIONS OF THE SECTION IN 1911–1912.

[Abbreviations.—M. = *Mare*; S. = *Sinus*; Fr. = *Fretum*; L. = *Lacus*; P. = *Palus*; F. = *Fons*; Depr. = *Depressio*; R. = *Regio*; Pr. = *Promontorium*.]